

Y-63

## ENTRANCE EXAMINATIONS – 2020

(Ph.D. Admissions - January 2021 Session)

### Ph.D. in Computer Science

Time: 2 Hours

Max. Marks: 70

Hall Ticket Number:

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#### INSTRUCTIONS

1. Write your Hall Ticket Number in the above box and on the OMR Sheet.
2. This test is for **2 hours duration** carrying **70 marks**.
3. Every correct answer gets **1 (one) mark**. There is **NO NEGATIVE MARKING**.
4. This test is objective type and has two parts: Part A contains 35 questions on Research Methodology, and Part B contains 35 questions on Computer Science. Please make sure that all the questions are clearly printed in your paper.
5. All answers should be marked clearly in the OMR answer sheet only.
6. Do not use any other paper, envelope etc. for writing or doing rough work. All the rough work should be done in your question paper or on the sheets provided with the question paper at the end.
7. During the examination, anyone found indulging in copying or have any discussions will be asked to leave the examination hall.
8. Use of non-programmable calculator and log-table are allowed.
9. Use of mobile phone is **strictly prohibited** inside the hall.
10. Submit the OMR sheet to the invigilator before leaving the examination hall.

## Part A – Research Methodology

1. Who among the following is **not** a computer scientist?
  - A. Vincent van Gogh
  - B. Vinton Cerf
  - C. Tim Berners-Lee
  - D. Dennis Ritchie
  
2. Which of these may be a title given to the computer scientist, James Gosling?
  - A. Dr. Python
  - B. Dr. Java
  - C. Dr. Lisp
  - D. Dr. Smalltalk
  
3. Which of the following has a storage capacity of about 700 MB?
  - A. DVD
  - B. Pen drive
  - C.  $1\frac{1}{4}$ -inch Floppy disk
  - D. CD-ROM
  
4. The set  $A = \{1, 2, 3, 4\}$  and  $R$  is the relation defined by  $(x, y) \in R$  if  $3x + 2y \leq 11$ . Which of the following statements is true for  $R$ ?
  - A.  $R$  is reflexive
  - B.  $R$  is symmetric
  - C.  $R$  is transitive
  - D. None of the above
  
5. What is the number of edges present in a complete graph having  $n$  vertices?
  - A.  $n(n + 1)/2$
  - B.  $n(n - 1)/2$
  - C.  $n$
  - D. Information given is insufficient
  
6. Which of the following propositional formula is a tautology?
  - A.  $(\bar{p} \vee r) \rightarrow (p \wedge \bar{r})$
  - B.  $\neg(p \rightarrow (p \wedge q))$
  - C.  $r \rightarrow (p \wedge \bar{r})$
  - D.  $(p \leftrightarrow q) \vee (p \leftrightarrow \bar{q})$

Questions 7–10 are based on the text below which is taken from the now famous review article on Deep Learning by Yann LeCun, Yoshua Bengio and Geoffrey Hinton in *Nature* (28 May 2015). Read it carefully and answer them.

Conventional machine-learning techniques were limited in their ability to process natural data in their raw form. For decades, constructing a pattern-recognition or machine-learning system

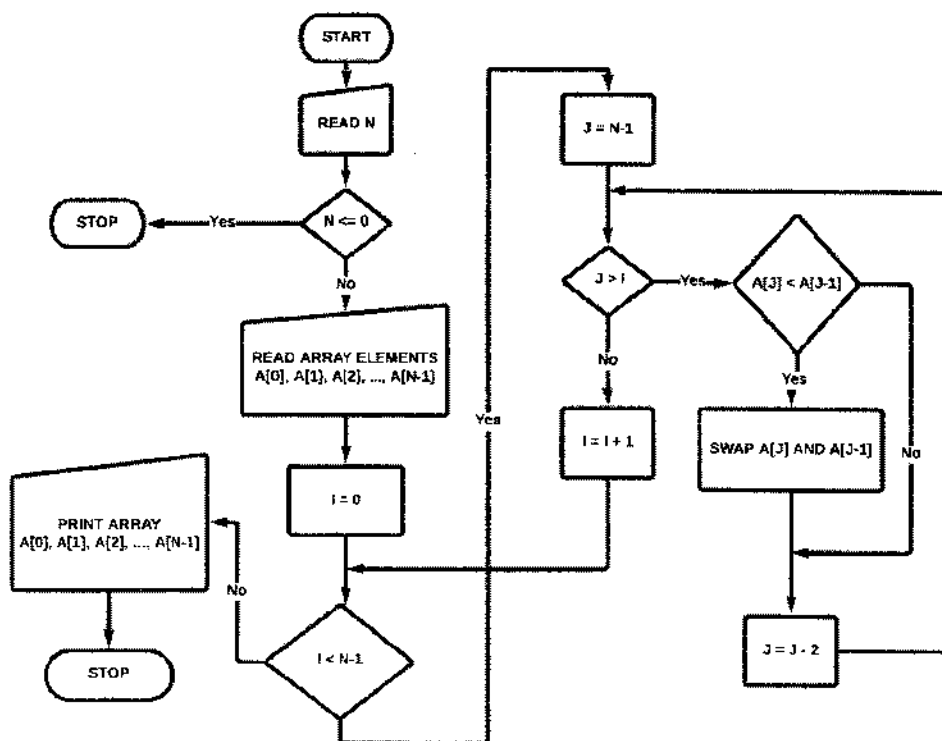
required careful engineering and considerable domain expertise to design a feature extractor that transformed the raw data (such as the pixel values of an image) into a suitable internal representation or feature vector from which the learning subsystem, often a classifier, could detect or classify patterns in the input.

Representation learning is a set of methods that allows a machine to be fed with raw data and to automatically discover the representations needed for detection or classification. Deep-learning methods are representation-learning methods with multiple levels of representation, obtained by composing simple but non-linear modules that each transform the representation at one level (starting with the raw input) into a representation at a higher, slightly more abstract level. With the composition of enough such transformations, very complex functions can be learned. For classification tasks, higher layers of representation amplify aspects of the input that are important for discrimination and suppress irrelevant variations. An image, for example, comes in the form of an array of pixel values, and the learned features in the first layer of representation typically represent the presence or absence of edges at particular orientations and locations in the image. The second layer typically detects motifs by spotting particular arrangements of edges, regardless of small variations in the edge positions. The third layer may assemble motifs into larger combinations that correspond to parts of familiar objects, and subsequent layers would detect objects as combinations of these parts. The key aspect of deep learning is that these layers of features are not designed by human engineers: they are learned from data using a general-purpose learning procedure.

7. The components needed to construct a machine-learning are
  - A. careful engineering and domain expertise
  - B. feature extractor and internal representation
  - C. domain expertise and learning subsystem
  - D. feature extractor and classifier
8. What is the function of higher layers of representation in classification tasks?
  - A. detect motifs and spot arrangements of edges
  - B. suppress irrelevant information and retain essential aspects
  - C. learn complex functions
  - D. detect familiar parts of objects
9. What is the key aspect of deep learning?
  - A. multiple levels of representations
  - B. object detection and classification
  - C. learning layers of features from data
  - D. human engineered layers of features
10. This is stated as one of the disadvantages of conventional machine learning
  - A. limited ability to process data in natural form
  - B. need far too many features
  - C. inability to learn complex functions
  - D. not requiring human engineers
11. The Android operating system on mobile phones is based on
  - A. Microsoft Windows operating system

- B. OS/360 operating system  
C. Linux operating system  
D. Ultrix operating system
12. Pick the odd one out.
- A. Cortana  
B. Alexa  
C. Pamela  
D. Siri
13. What is the value of  $c$ , if 8 is 4% of  $a$  and 4 is 8% of  $b$  and  $c$  equals  $b/a$ .
- A.  $1/4$   
B.  $1/2$   
C. 2  
D. 4
14. Police P runs at an average speed of 6Kmph on a highway road to catch thief T who is ahead of her by 8 metres. She is able to catch the thief after running for 100 metres despite a starting delay of 8 sec. What is the average speed of the thief T?
- A. 4.86 Kmph  
B. 3.86 Kmph  
C. 4.56 Kmph  
D. 3.56 Kmph
15. Suppose a number less than 1000 is picked randomly. What is the probability that it is a prime number?
- A.  $168/999$   
B.  $168/1000$   
C.  $1/168$   
D.  $158/999$

Questions 16–18 are based on the Flow-Chart given below. Trace it carefully and answer them.



16. What is the output array for  $N=8$  and the input array  $A = [2, 1, 4, 3, 6, 5, 8, 7]$ ?
- $[1, 2, 3, 4, 5, 6, 7, 8]$
  - $[2, 1, 4, 3, 5, 6, 7, 8]$
  - $[3, 4, 1, 2, 6, 5, 8, 7]$
  - $[4, 3, 2, 1, 8, 7, 6, 5]$
17. What is the output array for  $N=8$  and the input array  $A = [10, 32, 55, 77, 24, 46, 69, 81]$ ?
- $\{ 10, 24, 32, 46, 55, 69, 77, 81 \}$
  - $[10, 32, 55, 77, 24, 46, 69, 81]$
  - $[10, 24, 32, 55, 77, 46, 69, 81]$
  - $[10, 24, 32, 46, 55, 77, 69, 81]$
18. What is the output array given  $N=8$  and input array  $A = [80, 66, 59, 65, 39, 32, 19, 20]$ ?
- $[19, 20, 32, 39, 59, 65, 66, 80]$
  - $[80, 66, 65, 59, 39, 32, 20, 19]$
  - $[66, 80, 59, 65, 32, 39, 19, 20]$
  - $[59, 65, 66, 80, 19, 20, 32, 39]$
19. If the roots of the equation  $x^2 + ax + 1104 = 0$  have LCM equal to 552, what would be their GCD?
- 8
  - 4
  - 2

D. 23

20. An institute offered 60% concession of fee to Ms.X based on his performance in the entrance exam. Ms.X is offered an additional 40% discount on the remaining fee based on her previous academic record. Actual fee is 1.50 lakhs. How much amount does Ms.X have to pay to the institute?
- A. 0  
 B. 36000  
 C. 1,14,000  
 D. 24000

Answer the Questions 21–23 based on the data of Cases and Deaths due to a disease spread in four states as given below.

Population	March		April	
	Cases	Deaths	Cases	Deaths
State1(7Crores)	3202	194	3320	201
State2 (3Crores)	1131	187	1229	199
State3 (1Crores)	1640	38	1707	42
State4 (1.1Crores)	1021	38	1099	41

21. Which state has higher number of deaths per crore population in April?
- A. State 1  
 B. State 2  
 C. State 3  
 D. State 4
22. Which state has less number of total deaths in proportion to total cases?
- A. State 1  
 B. State 2  
 C. State 3  
 D. State 4
23. Which state has less number of total deaths in proportion to Population?
- A. State 1  
 B. State 2  
 C. State 3  
 D. State 4
24. The closed form solution of the recurrence relation  $a_n = a_{n-1} + n$  given  $a_0 = -3$  is
- A.  $\frac{n(n+1)}{2}$   
 B.  $\frac{(n+3)(n-2)}{2}$   
 C.  $\frac{(n-3)(n+3)}{3}$   
 D.  $(n - 3)$

25. In a group of students, there are 15 boys and 10 girls. If three students are selected at random, what is the probability that 1 girl and 2 boys are selected?
- A.  $21/46$
  - B.  $21/36$
  - C.  $21/26$
  - D.  $21/56$
26. What is size of the smallest subset that must be selected from the set  $\{1, 2, 3, 4, 5, 6\}$  to guarantee that at least one pair of numbers from this subset adds up to 7?
- A. 4
  - B. 5
  - C. 6
  - D. 3
27. A die is tossed 7 times. What is the probability that all six faces appear at least once?
- A.  $6!/6^7$
  - B.  $1/6^6$
  - C.  $6!/6^6$
  - D.  $6/6^6$
28. A man draws two cards together from a pack of 52 cards. What is the probability of both the cards being Queens?
- A.  $1/111$
  - B.  $1/121$
  - C.  $1/221$
  - D.  $1/321$
29. Given a set having 100 elements, what is the number of subsets having more than two elements?
- A.  $2^{100} - 4950$
  - B.  $2^{100} - 5051$
  - C.  $2^{100} - 101$
  - D.  $2^{100} - 1$
30. Which is the best possible probability distribution that is used to study queueing systems.
- A. Bernoulli distribution
  - B. Normal distribution
  - C. t-distribution
  - D. Poisson distribution
31. There are 100 gold coins, all are of equal weight except one defective coin having less weight. Suppose you are given a weighing balance without weights. As you count the number of weighings, when is the first possible weighing in which the defective coin may be found.
- A. 7
  - B. 6

- C. 4  
D. 3
32. A box contains 2 white balls, 3 black balls and 4 red balls. In how many ways can 3 balls be drawn from the box, if at least one black ball is to be included in the draw?
- A. 32  
B. 48  
C. 64  
D. 84
33. What is the angle between the minute hand and the hour hand of a clock when the time is 6.30?
- A.  $10^\circ$   
B.  $0^\circ$   
C.  $20^\circ$   
D.  $15^\circ$
34. A train running at  $\frac{2}{3}$  of its usual speed is 20 minutes late in reaching its destination. Find the original time it takes to cover the journey.
- A. 20 min  
B. 50 min  
C. 60 min  
D. 40 min
35. Out of 12 employees in a company one employee retires and in place of him a new employee of age 30 years joins. As a result, average age of the employees reduces by 3 years. Age of the retired employee is
- A. 55  
B. 65  
C. 66  
D. 75

TURN THE PAGE FOR PART B →



Part – B: Computer Science

36. The intersection of a context free language and a regular language is
- A. always regular
  - B. always context free
  - C. may or may not be context free
  - D. none of the above
37. What can be said regarding the following two statements about CYK algorithm?
- I It expects the input grammar to be in Chomsky normal form
  - II It is based on dynamic programming
- A. I is true, but II is false
  - B. I is false, but II is true
  - C. Both I and II are true
  - D. Both I and II are false
38. The minimum number of states in a deterministic finite automata (DFA) that will accept the language over the alphabet  $\Sigma = \{a, b\}$  consisting of all the strings with odd number of  $a$  and odd number of  $b$  is
- A. 2
  - B. 3
  - C. 4
  - D. 8
39. Which of the following grammars generates the language *EQUAL* consisting of all words having equal number of  $a$ 's and  $b$ 's ( $\lambda$  is null string)?
- A.  $S \rightarrow aSb \mid bSa \mid \lambda$
  - B.  $S \rightarrow abS \mid baS \mid \lambda$
  - C.  $S \rightarrow aSbS \mid bSaS \mid \lambda$
  - D. None of the above

40. What is the output of the following program, assuming int occupies 1 byte?

```
#include <stdio.h>
void main() {
int a[10];    int *i = &a[2], *j = &a[5];    int diff = j-i;
printf("%d", diff);
}
```

- A. 3
- B. 6
- C. Garbage Value
- D. Error

41. Which of the following is the correct prototype of a function that takes a character array as an argument and modification inside the function is forbidden?
- Func(char \* s)
  - Func(const char \*s)
  - Func(char const \* s)
  - None
42. If the binary max heap  $H = \{40, 10, 20, 9, 6, 19, 15\}$ , then what is the heap after the two operations DELETE-MAX() followed by HEAP-INSERT(25)?
- {25, 20, 19, 15, 10, 9, 6}
  - {25, 10, 9, 6, 15, 19}
  - {25, 10, 20, 9, 6, 19, 15}
  - {25, 10, 19, 9, 6, 15}
43. In a complete binary tree with 100 nodes what is the total number of nodes at height 1?
- 25
  - 32
  - 36
  - 24
44. What is the complexity of efficient way of finding the missing number in a given integer array of 1 to 100?
- $O(n \log n)$
  - $O(n)$
  - $O(n^2)$
  - $O(\log n)$
45. A tree has  $x$  vertices of degree 1, 2 vertices of degree 2, 4 vertices of degree 3 and 3 vertices of degree 4. What is the value of  $x$ ?
- 8
  - 10
  - 12
  - No tree is possible

Answer the Questions 46 - 47 based on the following code segment. Consider that the parameter *var* is initialized to 0 that indexes an array *arr*.

```
while (var < n)
{
    if (var == 0)
        var++;
    if (arr[var] >= arr[var - 1])
        var++;
    else
    {
```

```

        swap(arr[var], arr[var - 1]);
        var--;
    }
}

```

46. For the input array [4,8,2,6] how many iterations are required to get 2 to the beginning of the list.
- 3
  - 5
  - 2
  - 4
47. What are the best case and worst case complexities of the given algorithm?
- $O(n)$ ,  $O(n^2)$
  - $O(\log n)$ ,  $O(n)$
  - $O(n^2)$ ,  $O(n^2)$
  - $O(n)$ ,  $O(n \log n)$
48. Which of the following problems has a known algorithm of polynomial time complexity?
- Graph-colouring Problem
  - Travelling Salesperson Problem
  - Hamiltonian Circuit Problem
  - Linear Programming Problem
49. If  $N$  is an  $n$ -bit number, how many bits long is  $N!$ , approximately?
- $n \log n$
  - $n!$
  - $2^n$
  - $n^2$
50. An undirected graph with  $n$  nodes is represented by its adjacency matrix  $A$ . It is found that  $A^n$  has only 0's along its diagonal. Which of the following is then true about the graph represented by  $A$ ?
- The graph is planar
  - The graph is acyclic
  - The shortest path between any two nodes is longer than  $n$  hops
  - None of the above
51. What is the output of the following program?

```

int main() {
    char *str;
    str = "%s";
    printf(str, "K\n");
    return 0;
}

```

- A. No Output  
B. %s  
C. K  
D. Error
52. C programming language includes two types of modifiers that affect the way variables are accessed by both user's programme and the compiler. These modifiers are
- A. EXTERN, STATIC  
B. AUTO, REGISTER  
C. AUTO, EXTERN  
D. CONST, VOLATILE
53. What is the order of complexity of the following program?
- ```
sum=0;
for(i=1; i<=n; i=i*2)
for(j=1; j<=i; j++)
sum++;
```
- A.  $O(\log n)$   
B.  $O(n \log n)$   
C.  $O(n)$   
D.  $O(2^n)$
54. Which function has a return type as char pointer?
- A. getline  
B. fputs  
C. fgets  
D. All of the mentioned
55. Which of the following are hardware solutions for critical section problem for process synchronization?
- i Test and set  
ii Peterson's algorithm  
iii Compare and swap  
iv Bakery algorithm.
- A. (i), and (iii)  
B. (i) only  
C. (iii) only  
D. (ii) and (iv)
56. Determine the Average Turn-Around-Time, Wait-Time and Response-Time of the following process using round-robin scheduler with a time slice of 1 unit:

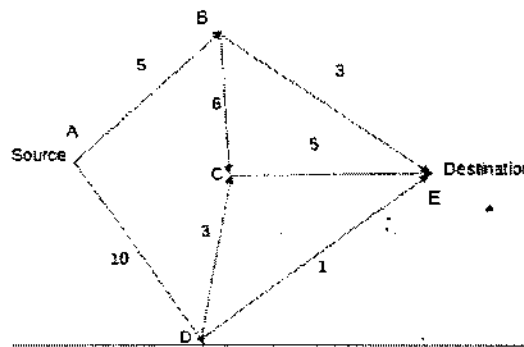
| Process | Arrival Time | Burst Time |
|---------|--------------|------------|
| A       | 0            | 1          |
| B       | 0            | 4          |
| C       | 0            | 2          |

- A. 4.33, 3, 2
- B. 4.33, 2, 1
- C. 4, 5, 6
- D. 4, 2, 1.33

57. If there are 64 segments each of size 1 kbyte, then the logical address should have
- A. 13 bits
  - B. 14 bits
  - C. 15 bits
  - D. 16 bits
58. Consider six memory partitions of size 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
59. Consider a computer with 8 Mbytes of main memory and 256 K cache. The cache block size is 4K. It uses a direct mapping scheme for cache management. How many different main memory blocks can map onto a given physical cache block?
- A. 2048
  - B. 256
  - C. 64
  - D. 32
60. Memory protection is normally done by
- A. the processor and the associated hardware
  - B. the operating system
  - C. the compiler
  - D. the user program
61. The correct matching for the following pairs is:
- |                   |                               |
|-------------------|-------------------------------|
| A. Buddy System   | 1.Run-time type specification |
| B. Interpretation | 2.Segmentation                |
| C. Pointer type   | 3.Memory allocation           |
| D. Virtual Memory | 4.Garbage collection          |

- A. A-3,B-4,C-2 and D-1
  - B. A-3,B-1,C-4 and D-2
  - C. A-4,B-3,C-2 and D-1
  - D. A-2,B-4,C-1 and D-3
62. An image is 1024 x 768 pixels with 3 bytes/pixel. Assume the image is uncompressed. How long does it take to transmit it over a 56kbps modem channel?
- A. 200 sec
  - B. 337.042 sec
  - C. 300 sec
  - D. 33.7042 sec
63. A particular system uses a page size of 1K bytes. A page table for a particular process (having 8 pages) contains [4, 6, \*, 2, \*, 7, \*, 3] (Note: The page table contains only list frame numbers corresponding to page number, a \* indicates that corresponding page is yet to be loaded into memory. Everything uses 0-based indexing).
- i) What physical address corresponds to the virtual address of 150?
  - ii) Find range of virtual addresses that will generate a page fault.
- A. 1074, (2048-3071, 4096-5119, 6144-7167)
  - B. 150, (2048-3071)
  - C. 4246, (2048-3071, 4096-5119, 6144-7167)
  - D. It cannot be determined
64. The correct matching for the following pairs is:
- |                         |               |
|-------------------------|---------------|
| a. Disk scheduling      | 1.Round Robin |
| b. Batch Processing     | 2.SCAN        |
| c. Time Sharing         | 3.LIFO        |
| d. Interrupt Processing | 4.FIFO        |
- A. a-3, b-4, c-2 and d-1
  - B. a-4, b-3, c-2 and d-1
  - C. a-2, b-4, c-1 and d-3
  - D. a-3, b-4, c-3 and d-2
65. One of the purposes of applying data integrity constraints in databases is
- A. Controlling that user to access data
  - B. Improving the quality of data entered for specific property
  - C. Data cannot be updated
  - D. Avoiding to enter duplicate records
66. Which of the following (min(M), max(N)) conditions means a partial participation of the relation in a relationship?
- A. 0:N
  - B. 0:M

- C. 1:N
  - D. Both A and B above
67. There is a relation R with the functional dependencies of the form  $X \rightarrow Y$ . For each of these functional dependencies, the left side component (attribute X) is a key. What is the highest normal form(NF) satisfied by the relation R?
- A. BCNF
  - B. 1NF
  - C. 2NF
  - D. 3NF
68. Which lock is acquired by a transaction so that both read and write operations are performed on the same data item?
- A. Shared mode
  - B. Exclusive mode
  - C. Write mode
  - D. Shared and exclusive mode
69. What is speculative execution in MapReduce/Hadoop?
- A. Speculatively allocate more nodes to handle future MapReduce tasks
  - B. Certain number of duplicate tasks are launched on same slave node to handle the fault-tolerance issue
  - C. Speculatively terminate some nodes in MapReduce cluster for conservation of energy
  - D. Certain number of duplicate tasks are launched on different slave nodes to handle the fault-tolerance issue
70. In the following directed network, each edge represents the capacity of the link as amount of Giga bits per second that can pass through it at any given time. Assuming the flow property of conservation, what is the maximum possible flow in this network that can reach from the source to the destination?



- A. 15
- B. 9
- C. 13
- D. 7


THE END

**University of Hyderabad**  
**Entrance Examinations - 2020**

School/Department/Centre : School of Computer and Information Sciences  
Course/Subject : PhD in Computer Science

| Q.No. | Answer | Q.No. | Answer | Q.No. | Answer | Q.No. | Answer |
|-------|--------|-------|--------|-------|--------|-------|--------|
| 1     | A      | 26    | A      | 51    | C      | 76    |        |
| 2     | B      | 27    | C      | 52    | D      | 77    |        |
| 3     | D      | 28    | C      | 53    | C      | 78    |        |
| 4     | D      | 29    | B      | 54    | C      | 79    |        |
| 5     | B      | 30    | D      | 55    | A      | 80    |        |
| 6     | D      | 31    | D      | 56    | B      | 81    |        |
| 7     | D      | 32    | C      | 57    | D      | 82    |        |
| 8     | B      | 33    | D      | 58    | A      | 83    |        |
| 9     | C      | 34    | D      | 59    | D      | 84    |        |
| 10    | A      | 35    | C      | 60    | A      | 85    |        |
| 11    | C      | 36    | B      | 61    | B      | 86    |        |
| 12    | C      | 37    | C      | 62    | B      | 87    |        |
| 13    | A      | 38    | C      | 63    | C      | 88    |        |
| 14    | A      | 39    | C      | 64    | C      | 89    |        |
| 15    | A      | 40    | A      | 65    | B      | 90    |        |
| 16    | A      | 41    | B      | 66    | D      | 91    |        |
| 17    | B      | 42    | D      | 67    | A      | 92    |        |
| 18    | C      | 43    | A      | 68    | B      | 93    |        |
| 19    | C      | 44    | D      | 69    | D      | 94    |        |
| 20    | B      | 45    | C      | 70    | D      | 95    |        |
| 21    | B      | 46    | A      | 71    |        | 96    |        |
| 22    | C      | 47    | A      | 72    |        | 97    |        |
| 23    | A      | 48    | D      | 73    |        | 98    |        |
| 24    | B      | 49    | D      | 74    |        | 99    |        |
| 25    | A      | 50    | B      | 75    |        | 100   |        |

Note/Remarks : The paper contains 70 questions only.

  
 Signature 25/11/2024  
 School/Department/Centre