Test Centre : _____

Roll No. : _____

Name of the Candidate : _____

S A U

Entrance Test for Ph.D. (Computer Science) 2018

[PROGRAMME CODE : 50004]

Question Paper Series Code : B

QUESTION PAPER

Time : 3 hours *Maximum Marks* : 70

INSTRUCTIONS FOR CANDIDATES

Please read carefully the following instructions before attempting the Question Paper :

(i) Write your Name, Roll Number and Name of the Test Centre in the space provided for the purpose on the top of this Question Paper and on the OMR Sheet.

(ii) This Question Paper has Two Parts : Part—A and Part—B.

(iii) Part—A (objective-type) has **30** questions of **1** mark each. All questions are compulsory.

(iv) Part—B (objective-type) has **40** questions of **1** mark each. All questions are compulsory.

(v) **A wrong answer will lead to the deduction of one-fourth of the marks assigned to that questions.**

(vi) *Symbols have their usual meanings.*

(vii) **Please darken the appropriate circle of 'Question Paper Series Code' and 'Programme Code' on the OMR Sheet in the space provided.**

(viii) All questions should be answered on the OMR Sheet.

(ix) Answers written inside the Question Paper will **NOT** be evaluated.

(x) Calculators and Log Tables may be used. **Mobile Phones are NOT allowed.**

(xi) Pages at the end of the Question Paper have been provided for Rough Work.

(xii) **Return the Question Paper and the OMR Sheet** to the Invigilator at the end of the Entrance Test.

(xiii) **DO NOT FOLD THE OMR SHEET.**

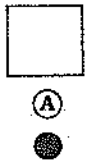
INSTRUCTIONS FOR MARKING ANSWERS ON THE 'OMR SHEET'

Use BLUE/BLACK Ballpoint Pen Only

1. **Please ensure that you have darkened the appropriate circle of 'Question Paper Series Code' and 'Programme Code' on the OMR Sheet in the space provided.**

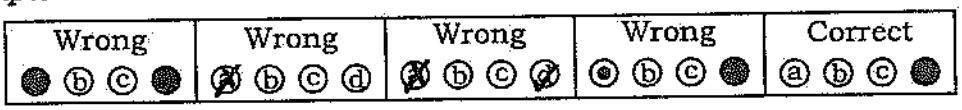
   Question Paper Series Code

   Write Question Paper Series Code **A** or **B** in the box and darken the appropriate circle.

2. Use only Blue/Black Ballpoint Pen to darken the circle. Do not use Pencil to darken the circle for Final Answer.
3. Please darken the whole circle. ●
4. Darken ONLY ONE CIRCLE for each question as shown below in the example :

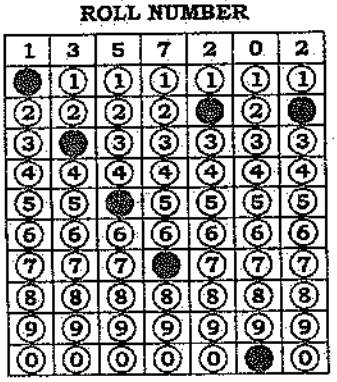
   Example :

5. Once marked, no change in the answer is possible.
6. Please do not make any stray marks on the OMR Sheet.
7. Please do not do any Rough Work on the OMR Sheet.
8. Mark your answer only in the appropriate circle against the number corresponding to the question.
9. **A wrong answer will lead to the deduction of one-fourth of the marks assigned to that question.**
10. Write your seven-digit Roll Number in small boxes provided for the purpose; and also darken the appropriate circle corresponding to respective digits of your Roll Number as shown in the example below.

    Example :

    ROLL NUMBER

PART—A

1. Given $A = \begin{vmatrix} 1 & 3 & -2 \\ 4 & -5 & 6 \\ 3 & 5 & 2 \end{vmatrix}$, what is the cofactor of the second element of its first row?

   a. 21

   b. 10

   c. –10

   d. –21

2. What is the value of

$$A = \begin{vmatrix} a+b+c & -c & -b \\ -c & a+b+c & -a \\ -b & -a & a+b+c \end{vmatrix} ?$$

   a. 0

   b. abc

   c. $(a+b+c)$

   d. $2(a+b)(b+c)(c+a)$

3. If $A = \begin{pmatrix} 3 & -3 & 4 \\ 2 & -3 & 4 \\ 0 & -1 & 1 \end{pmatrix}$, then which of the following is ***true***?

   a. $A^{-1} = A^2$

   b. $A^{-1} = A^3$

   c. $A^{-1} = A$

   d. None of the above

4. Given a matrix $A = \begin{pmatrix} -1 & 2 & 3 \\ 0 & 3 & 5 \\ 0 & 0 & -2 \end{pmatrix}$, the eigenvalues of A^2 are

   a. –1, 9, 4

   b. –1, 9, –4

   c. –1, –9, 4

   d. 1, 9, 4

5. What is the output of the following C code?

```
int main( )
{
    float x = 0·1;
    if (x == 0·1)
        printf("IF");
    else if (x == 0·1f)
        printf ("ELSE IF");
    else
        printf ("ELSE");
}
```

a. ELSE IF

b. IF

c. ELSE

d. IF ELSE

6. What is the output of the following C code?

```
void main ()
{
    int i = 065, j = 65;
    printf ("%d%d", i, j);
}
```

a. 53, 65

b. 65, 65

c. 065, 65

d. None of the above

7. Consider the following recursive function fun (x, y). What is the value of fun(4, 3)?

```
int fun (int x, int y)
{
  if (x == 0)
    return y;
  return fun( x - 1, x + y );
}
```

a. 12

b. 13

c. 9

d. None of the above

8. What does the following program print?

```
void f(int *p, int *q)
{
  p = q;
  *p = 2;
}
int i = 0, j = 1;
int main( )
{
  f(&i, &j);
  printf ("%d%d\n", i, j);
  return 0;
}
```

a. 2 2

b. 2 1

c. 0 1

d. 0 2

9. Consider the following declaration of a two-dimensional array in C :

```
char a [100] [100];
```

Assuming that the main memory is byte-addressable and that the array is stored starting from memory address 0, the address of a[40] [50] is

a. 2000

b. 4050

c. 5040

d. 5050

10. Conversion of $(64.1F)_{16}$ will give

a. $(100.12109375)_{10}$

b. $(144.076)_{8}$

c. $(1100100.00011111)_{2}$

d. All of the above

11. If x and y are two binary variables, then which of the following is ***false*** ?

a. $x + x = x$

b. $x + x.y = x$

c. $x + yz = (x + y)(x + z)$

d. None of the above

12. Which of the following can be called a literal?

a. Primed variable

b. Unprimed variable

c. Both a. and b.

d. None of the above

13. For a shift register, which of the following is ***false*** ?

a. It can shift binary information only from left to right.

b. It uses flip-flops in parallel.

c. It uses different clock pulses for different flip-flops.

d. All of the above

14. How many input ports are there in a BCD to decimal decoder?

a. One

b. Two

c. Three

d. Four

15. If Z-optimal denotes the optimal value of the following LPP

Max $Z = 4x + 3y$

subject to

$$2x + y \geq 10$$
$$x + y \leq 8$$
$$x \geq 0,\ y \geq 0$$

then

a. Z-optimal ≥ 41

b. $30 \leq Z$-optimal ≤ 40

c. $24 \leq Z$-optimal ≤ 29

d. Z-optimal ≤ 23

16. The LPP given below

Min $Z = x + 2y$

subject to

$$x + y \leq 1$$
$$2x + y \geq 4$$
$$x \geq 0,\ y \geq 0$$

has/is

a. a unique optimal solution

b. many optimal solutions

c. no feasible solution

d. unbounded

17. Consider the following LPP (LP) :

Min $Z = 8x + 10y$

subject to

$$x + 2y \geq 4$$
$$x + y \geq 3$$
$$x \geq 0,\ y \geq 0$$

Let LD be the dual of the LP. Let Z-optimal be the optimal value of LP and W-optimal be the optimal value of LD. Then

a. Z-optimal – W-optimal < 0

b. Z-optimal – W-optimal > 0

c. Z-optimal and W-optimal are not finite quantities

d. Z-optimal – W-optimal $= 0$

18. Consider the following LPP :

$$\text{Max } Z = 4x - y + 2z$$

subject to

$$x + 5y + 25z = 125$$
$$x \geq 0,\ y \geq 0,\ z \geq 0$$

Let $X = (x = 100,\ y = 5,\ z = 0)$ be given. Then

a. X is a basic solution which is not feasible

b. X is a basic solution which is feasible

c. X is not a basic solution, but it is feasible

d. X is neither a basic solution nor a feasible solution

19. Let $f(x) = |\sin x|$, where x is real number. Then f is

a. a convex function

b. a concave function

c. neither a convex function nor a concave function

d. both convex and concave functions

20. If f be real-valued convex function, and $y \in R$ is such that the derivative of f at y is zero, then

a. y is a minimum point

b. y is a maximum point

c. y is neither a minimum nor a maximum point

d. f is a constant function

21. If $f(x) = px^2 + qx + c$, where p and q are non-zero coefficients and $f(x)$ attains its minimum for $x^* = -1$, then

a. $q = 2p$ b. $q = 2p,\ p > 0$

c. $p = 2q$ d. $p = 2q,\ q > 0$

22. For two events E and F, if $P(E) = 0{\cdot}9$ and $P(F) = 0{\cdot}9$, then $P(E \cap F) + P(E \cup F)$ is in the interval

a. $[0,\ 0{\cdot}5]$ b. $[0{\cdot}5,\ 1]$

c. $[1{\cdot}5,\ 2]$ d. $[1,\ 1{\cdot}5]$

23. Let $E(X) = 2$ and $E(X^2) = 8$. If $Y = (2+4X)^2$, then $E(Y)$ equals

a. 164

b. 160

c. 132

d. 128

24. Let E and F be two events in a sample space S. If $p = P(E)P(F/E) + P(E^c)P(F/E^c)$, then p equals

a. $P(F)$

b. $P(S)$

c. $P(F^c)$

d. $P(E \cup F)$

25. Suppose that the average number of accidents occurring weekly on a particular crossing of a city is 3. Let Poisson distribution be used to calculate the probability p that at least one accident will occur in the current week, then

a. $p = e^{-3}$

b. $p = 1 - e^{-3}$

c. $p = e^{-3} - 1$

d. $p = e^{-3}/3$

26. Let X be a random variable which follows binomial distribution with parameters n and p. If it is known that the mean of the distribution is 5 and variance is 5/2, then

a. $n = 10,\ p = 0{\cdot}5$

b. $n = 20,\ p = 0{\cdot}25$

c. $n = 10,\ p = 0{\cdot}25$

d. $n = 20,\ p = 0{\cdot}5$

27. $MNOP$ is a prarlleogram, A is the midpoint of NO and B is the midpoint of OP. If $\overrightarrow{MN} = \vec{m}$ and $\overrightarrow{MP} = \vec{n}$, then the vectors $\overrightarrow{MA}$ and $\overrightarrow{AP}$ in terms of $\vec{m}$ and $\vec{n}$ are _____ and _____, respectively.

a. $\vec{m} + \frac{\vec{n}}{2}, \frac{\vec{n}}{2} - \vec{m}$

b. $\vec{m} - \frac{\vec{n}}{2}, \frac{\vec{n}}{2} + \vec{m}$

c. $\vec{m} - \frac{\vec{n}}{2}, \frac{\vec{n}}{2} - \vec{m}$

d. $\vec{m} + \frac{\vec{n}}{2}, \frac{\vec{n}}{2} + \vec{m}$

28. A unit vector, perpendicular to both $\vec{M} = 2\hat{i} - 3\hat{j} + \hat{k}$ and $\vec{N} = 7\hat{i} - 5\hat{j} + \hat{k}$, is

a. $\frac{2\hat{i} - 5\hat{j} + 11\hat{k}}{5\sqrt{6}}$

b. $\frac{2\hat{i} + 5\hat{j} + 11\hat{k}}{5\sqrt{6}}$

c. $\frac{2\hat{i} + 5\hat{j} - 11\hat{k}}{5\sqrt{6}}$

d. $\frac{2\hat{i} - 5\hat{j} - 11\hat{k}}{5\sqrt{6}}$

29. What is the angle between the tangents to the curve $\vec{r}(t) = t^2\hat{i} + 2t\hat{j} - t^3\hat{k}$ at $t = \pm 1$?

a. $\sin^{-1}\left(\frac{17}{9}\right)$

b. $\sin^{-1}\left(\frac{9}{17}\right)$

c. $\cos^{-1}\left(\frac{17}{9}\right)$

d. $\cos^{-1}\left(\frac{9}{17}\right)$

30. What will be the values of a, b and c for the vectors $2\hat{i} + 3\hat{j} - 4\hat{k}$ and $a\hat{i} + b\hat{j} + c\hat{k}$ to be perpendicular?

a. $a = 2,\ b = 3,\ c = -4$

b. $a = 4,\ b = 4,\ c = 5$

c. $a = 4,\ b = 3,\ c = -5$

d. $a = 3,\ b = 5,\ c = -4$

PART—B

31. What is the minimum sampling rate required (according to the Nyquist theorem) for modulating an analog signal into a digital signal using Pulse Code Modulation (PCM), if the bandwidth of the input signal is 10000 Hz in the range of 1000 Hz to 11000 Hz?

a. 10000 samples/second

b. 20000 samples/second

c. 11000 samples/second

d. 22000 samples/second

32. In a network 200.10.11.144/27, what is the fourth octet (in decimal-dotted notation) of the last IP address that can be assigned to a host?

a. 158

b. 255

c. 222

d. 223

33. Host *A* (on a TCP/IPv4 network *A*) sends an IP datagram *D* to host *B* (also on a TCP/IPv4 network *B*). Assume that no error occurred during the transmission of *D*. When *D* reaches *B*, then which of the following IP header field(s) may be different from that of the original datagram *D*?

(i) TTL

(ii) Checksum

(iii) Fragment Offset

a. (i) only

b. (i) and (ii) only

c. (ii) and (iii) only

d. (i), (ii) and (iii)

34. What is the bit rate for a 1000-baud 16-QAM signal?

a. 1000 bps

b. 2000 bps

c. 4000 bps

d. 8000 bps

35. A subnet has been assigned a subnet mask of 255.255.255.192. What is the maximum number of hosts that can belong to this subnet?

a. 62

b. 30

c. 126

d. 14

36. Which one of the following refers to the set of activities that ensure that a software has been built according to the need of clients?

a. Verification

b. Validation

c. Debugging

d. Augmentation

37. Which one of the following measures the intra-dependability among the elements of the module?

a. Coupling

b. White box testing

c. Cohesion

d. Black-box testing

38. The acronym 'ACID' stands for

a. Atomicity, Consistency, Isolation, Durability

b. Atomicity, Consistency, Integrity, Durability

c. Atomicity, Consistency, Independence, Durability

d. Atomicity, Consistency, Interchange, Durability

39. Consider a relation with 6 attributes namely A, B, C, D, E and F. What is the maximum possible candidate key that can be generated if attribute D is excluded from the sample?

a. $2^6 - 1$

b. $2^{(6-1)} - 1$

c. $2^6 - 2$

d. 2^6

40. The _____ key is an intra-relation constraint, whereas the _____ key is an inter-relation constraint.

a. Primary; unique

b. Foreign; primary

c. Primary; foreign

d. Foreign; unique

41. With respect to the E-R diagram, match the following :

List—I	*List—II*
I. Triangle	P. Weak entity set
II. Double rectangle	Q. Derived attribute
III. Dashed ellipse	R. Multivalued attribute
IV. Double ellipse	S. Specialization

a. I–R, II–P, III–Q, IV–S

b. I–S, II–P, III–Q, IV–R

c. I–P, II–Q, III–R, IV–S

d. I–Q, II–P, III–S, IV–R

42. Consider the following set F of functional dependencies on schema $R(P, Q, R)$:

$$F = \{P \rightarrow QR,\ Q \rightarrow R,\ P \rightarrow Q,\ PQ \rightarrow R\}$$

Compute the canonical cover for F.

a. $F_C = \{P \rightarrow Q,\ Q \rightarrow R\}$

b. $F_C = \{P \rightarrow Q,\ Q \rightarrow R,\ PQ \rightarrow R\}$

c. $F_C = \{Q \rightarrow R,\ PQ \rightarrow R\}$

d. $F_C = \{Q \rightarrow QR,\ PQ \rightarrow R\}$

43. Consider the following set F of functional dependencies on relation schema $R(A, B, C, D, E)$:

$$F = \{AB \rightarrow C,\ C \rightarrow A,\ C \rightarrow D,\ D \rightarrow E,\ E \rightarrow D\}$$

Let there be two decompositions of R :

$D_1 : R_{11}(C, D)$ & $R_{12}(A, B, C, E)$

$D_2 : R_{21}(C, D)$, $R_{22}(D, E)$ & $R_{23}(A, B, C)$

Which one of the following is ***true***?

a. Both decompositions D_1 and D_2 are lossy

b. Both decompositions D_1 and D_2 are lossless

c. Decomposition D_1 is lossy and Decomposition D_2 is lossless

d. Decomposition D_1 is lossless and Decomposition D_2 is lossy

44. Which one of the following MIPS instructions is used to shift data left?

a. sl

b. sll

c. ls

d. None of the above

45. Which one of the following registers is ***not*** used for recursive function executions in MIPS?

a. $a0–$a3

b. $v0–$v1

c. $sp

d. None of the above

46. Which one of the following is used as bias for representing exponents in double-precision IEEE 754 floating-point format?

a. 127

b. 128

c. 1023

d. 1024

47. What is the width of the main control output 'ALUOp' in the MIPS single-cycle data path implementation?

a. 1 bit

b. 2 bits

c. 3 bits

d. 4 bits

48. How many fields are there in an *R*-type MIPS instruction?

a. 2

b. 4

c. 5

d. 6

49. Which one of the following is used as a solution of the load-use data hazard?

a. Forwarding

b. Stall

c. Both a. and b. together

d. Prediction

50. How many distinct binary search trees (BST) can be created out of four distinct keys?

a. 5

b. 24

c. 14

d. 42

51. 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. 3

c. 4

d. 5

52. How many undirected graphs (not necessarily connected) can be constructed out of a given set of n vertices?

a. $n(n-1)/2$

b. 2^n

c. $n!$

d. $2^{n(n-1)/2}$

53. If a simple graph G contains n vertices and m edges, then the number of edges in the graph G' (complement of G) is

a. $(n^2-n-2m)/2$

b. $(n^2+n-2m)/2$

c. $(n^2-n+2m)/2$

d. $(n^2+n+2m)/2$

54. Assume that the operators +, −, × are left associatives and ^ is right associative, and the order of precedence (from highest to lowest) is ^, ×, +, −. The postfix expression corresponding to the infix expression a + b×c − d^e^f is

a. ab+c×d−e^f^

b. abc×+de^f^−

c. abc×+def^^−

d. −+a×bc^^def

55. Consider a hash table with 100 slots, and collisions are resolved using chaining. Assuming simple uniform hashing, what is the probability that the first 3 slots are unfilled after the first 3 insertions?

a. $(97\times97\times97)/100^3$

b. $(99\times98\times97)/100^3$

c. $(97\times96\times95)/100^3$

d. $(97\times97\times97)/(3!\times100^3)$

56. The run time of quicksort heavily depends on the selection of

a. number of inputs

b. arrangement of elements in an array

c. size of elements

d. pivot element

57. The solution of the recurrence equation $T(n) = T(n/2) + n$ is

a. $O(\log n)$

b. $O(n)$

c. $O(n\log n)$

d. $O(n^2)$

58. If an array is already sorted, then which of the following algorithms will exhibit the best performance?

a. Merge sort

b. Insertion sort

c. Quicksort

d. Heap sort

59. Let S be an *NP*-complete problem and Q and R be two other problems not known to be in *NP*. If Q is polynomial-time reducible to S and S is polynomial-time reducible to R, then which one of the following statements is ***true***?

a. R is *NP*-complete.

b. R is *NP*-hard.

c. Q is *NP*-complete.

d. Q is *NP*-hard.

60. The approaches used for solving dynamic programming are similar to the _____ approach.

a. parsing

b. hash table

c. greedy

d. divide and conquer

61. For an input of length n, linked list search complexity is

a. $O(1)$

b. $O(n)$

c. $O(\log n)$

d. $O(\log \log n)$

62. Which one of the following is ***not*** a major activity of an operating system with regard to process management?

a. Creation and deletion of processes

b. Keeping track of which parts of memory are currently being used and by whom

c. Process synchronization

d. Process communication

63. Which one of the following is ***not*** a CPU scheduling algorithm?

a. SJF

b. FIFO

c. Round robin

d. LRU

64. Which one of the following allows user-level processes to request services of the operating system?

a. Thrashing

b. Virtual memory

c. System call

d. Associative memory

65. Which one of the following sections changes the value of semaphore?

a. Critical section

b. Non-critical section

c. Entry section

d. Remainder section

66. When a non-recursive mutex is locked more than once, then it causes

a. thrashing

b. deadlock

c. aging

d. starvation

67. Page replacement algorithms work on the principle of

a. random access

b. globalization

c. locality

d. modularity

68. How many pair(s) of Cat 5 UTP is/are used in 1000Base-T Ethernet standard?

a. 1

b. 2

c. 4

d. 8

69. When the hop-count field in an IP packet reaches zero and the destination has not been reached, which ICMP error message is sent back to the sending machine?

a. Destination-unreachable

b. Time-exceeded

c. Parameter-problem

d. Redirection

70. If a digital signal has a bit interval of 40 microseconds, then what will be the bit rate?

a. 8 Kbps

b. 16 Kbps

c. 20 Kbps

d. 25 Kbps

SPACE FOR ROUGH WORK

SPACE FOR ROUGH WORK

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★★★