12

QUESTION PAPER SERIES CODE
A

Centre of Examination : _____

Roll No. : _____

Name of Candidate : _____

S A U

Entrance Test for Ph.D. (Computer Science)

[2013]

Time : 3 hours *Maximum Marks* : 70

INSTRUCTIONS FOR CANDIDATES

Candidates must carefully read the following instructions before attempting the Question Paper :

(i) Write your Name and Roll Number in the space provided for the purpose on the top of this Question Paper and in the OMR/Answer 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) Symbols have their usual meanings.

(vi) **Please darken the appropriate Circle of 'Question Paper Series Code' on the OMR Sheet in the space provided.**

(vii) Questions of both the parts should be answered on OMR Sheet.

(viii) Answers written by the candidates inside the Question Paper will **NOT** be evaluated.

(ix) Calculators and Log Tables may be used.

(x) Pages at the end have been provided for Rough Work.

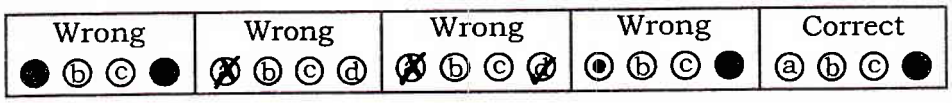
(xi) **Return the Question Paper and the OMR Sheet** to the Invigilator at the end of the Entrance Test.

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

INSTRUCTIONS FOR MARKING ANSWERS IN THE 'OMR SHEET'

1. **Please ensure that you have darkened the appropriate Circle of 'Question Paper Series Code' on the OMR Sheet in the space provided.**
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 allowed.
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. There will be no negative marking in evaluation.

PART—A

1. If $L = \{(x, y) | y = e^x, x \in R\}$ and $M = \{(x, y) | y^2 = x, x \in R\}$, then

   (a) $M \subseteq L$

   (b) $L \subseteq M$

   (c) $L \cap M = \phi$

   (d) $L \cup M = L$

2. Which of the following statements is the negation of the statement '4 is even or -5 is negative'?

   (a) 4 is odd and -5 is not negative

   (b) 4 is even or -5 is not negative

   (c) 4 is odd or -5 is not negative

   (d) 4 is even and -5 is not negative

3. 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) 40

   (b) 45

   (c) 96

   (d) 64

4. The probability of solving a question by three students are $\frac{1}{2}$, $\frac{1}{4}$ and $\frac{1}{6}$ respectively. Probability of question being solved will be

   (a) $\frac{31}{48}$

   (b) $\frac{33}{48}$

   (c) $\frac{35}{48}$

   (d) $\frac{37}{48}$

5. The mean and variance of a binomial distribution are 4 and 3 respectively. Then the probability of getting exactly six successes in this distribution is

(a) $^{16}C_6\left(\frac{1}{4}\right)^6\left(\frac{3}{4}\right)^{10}$

(b) $^{16}C_6\left(\frac{1}{4}\right)^{16}\left(\frac{3}{4}\right)^{20}$

(c) $^{16}C_6\left(\frac{1}{4}\right)^8\left(\frac{3}{4}\right)^{12}$

(d) $^{16}C_6\left(\frac{1}{4}\right)^{12}\left(\frac{3}{4}\right)^{16}$

6. One in five of the general population are left-handed. The probability that of four randomly selected people, three becoming left-handed is approximately

(a) 0·200

(b) 0·600

(c) 0·037

(d) 0·026

7. $\lim_{n\to\infty} \frac{1^2+2^2+\cdots+n^2}{n^3}$ will be

(a) 1

(b) −1

(c) $\frac{1}{2}$

(d) $\frac{1}{3}$

8. The maximum value of $\frac{\log x}{x}$ will be

(a) e

(b) $e^{\frac{1}{e}}$

(c) $\frac{1}{e}$

(d) e^2

9. The value of $\int \frac{dx}{1+e^x}$ is

(a) $\frac{e^x}{1+e^x}+c$

(b) $\log\left(\frac{e^x}{1+e^x}\right)+c$

(c) $\log(1+e^x)+c$

(d) $\log e^x+c$

10. The particular integral of $\frac{d^2y}{dx^2}+y=\cos x$ is

(a) $\frac{x\sin x}{2}$

(b) $\frac{x\cos x}{2}$

(c) $\frac{xe^x}{2}$

(d) $\frac{x\tan x}{2}$

11. The integrating factor of $(x^2+y^2)dx=2xydy$ is

(a) $\frac{-1}{x^2}$

(b) $\frac{1}{x^2}$

(c) $\frac{-1}{x}$

(d) $\frac{1}{x}$

12. What will be the equation of tangent to parabola $y^2=7x$, which is parallel to straight line $4y-x+3=0$?

(a) $4y-x+28=0$

(b) $x-4y+14=0$

(c) $4y-x+14=0$

(d) $x-4y+28=0$

13. The perpendicular distance between the lines $3x+4y+7=0$ and $3x+4y-3=0$ will be

(a) 4

(b) 3

(c) 2

(d) 1

14. What will be the equation of circle whose equations of diameters are $x+y=6$ and $x+2y=4$ and its radius is 10?

(a) $x^2+y^2+16x+12y-5=0$

(b) $x^2+y^2+13x-11y-8=0$

(c) $x^2+y^2+7x-5y+6=0$

(d) $x^2+y^2-16x+4y-32=0$

15. The angle between the vectors $\vec{a}=3\hat{i}-2\hat{j}+\hat{k}$ and $\vec{b}=2\hat{i}+\hat{j}+3\hat{k}$ is

(a) 75°

(b) 60°

(c) 45°

(d) 30°

16. $\hat{i}\cdot(\hat{j}\times\hat{k})+\hat{j}\cdot(\hat{i}\times\hat{k})+\hat{k}\cdot(\hat{i}\times\hat{j})$ is equal to

(a) 3

(b) -3

(c) 0

(d) 1

17. If $M=[a_{ij}]_{m\times n}$ be a matrix such that $a_{ij}=1$ for all i and j, then

(a) rank $(M)=m$

(b) rank $(M)=n$

(c) rank $(M)>1$

(d) rank $(M)=1$

18. If $a\neq b\neq c$, then the value of x satisfying the equation $\det\begin{bmatrix}0 & x-a & x-b\\ x+a & 0 & x-c\\ x+b & x+c & 0\end{bmatrix}=0$ is

(a) a

(b) b

(c) c

(d) 0

19. What is the output of the following program?

```
#include <stdio.h>
void main( )
{
        int i, j, k;
i=2;
j=4;
k=i++>j&2;
if(++k && ++i<– –j|| i++)
{
   j=++k;
}
printf("%d %d %d",i,–j– –,k);
getchar( )
}
```

(a) 4 –3 2 (b) 5 –3 2

(c) 4 –2 2 (d) 5 –2 2

20. What is the output of the following program?

```
#include <stdio.h>
void main( )
{
int i=0;
for(i=0;i<20;i++)
{
      switch(i)
      {
      case 0:
      i+=5;
      case 1:
      i+=2;
      case 5:
      i+=5;
      default:
      i+=4;
      break;
      }
      printf("%d", i);
}
getchar( );
}
```

(a) 4 4 (b) 4 2

(c) 5 20 (d) 16 21

21. What is the output of the following program?

```
#include <stdio.h>
#include <string.h>
void main( )
{
char s1[10]="abcd";
char s2[10];
char s3[10]="efgh";
int i;
i=strcmp(strcat(s3,strcpy(s2,s1)),strcat(s3,"abcd"));
printf("%d",i);
getch( );
}
```

(a) 0

(b) –1

(c) 1

(d) 2

22. How many times the pattern "South Asian University" will get printed?

```
void main( )
{
int x;
for(x=–1; x<=10; x++)
{
  if(x<5)
    continue;
  else
    break;
  printf("South Asian University");
}
}
```

(a) Infinite times

(b) 0 times

(c) 11 times

(d) 6 times

23. Consider the following recursive function :

```
int fun (int n)
{
  If (n = = 4)
    return 2;
  else
    return 2 * fun (n + 1);
}
```

What is the value returned by the function call fun (2)?

(a) 2

(b) 4

(c) 8

(d) 16

24. Which of the following cannot be checked in a switch-case statement?

(a) enum

(b) float

(c) int

(d) char

25. The memory address of the first element of an array is called

(a) floor address

(b) foundation address

(c) first address

(d) base address

26. If a signal passing through a gate is inhibited by sending a LOW into one of the inputs, and the output is HIGH, the gate is

(a) AND

(b) NAND

(c) NOR

(d) OR

27. Simplified form of the Boolean expression $(X + Y + XY)(X + Z)$ is

(a) $X + Y + Z$

(b) $XY + YZ$

(c) $X + YZ$

(d) $XZ + Y$

28. In the following Karnaugh map, corresponding switching function in its minimal form is

YZ \ WX	00	01	11	10
00	1	1	1	
01				
11		1	1	
10	1		1	1

(a) $F(w, x, y, z) = x'z'$

(b) $F(w, x, y, z) = (x' + z') + (w + z')(x + y + z)$

(c) $F(w, x, y, z) = xz + w'z + x'y'z'$

(d) $F(w, x, y, z) = x'z' + wz'wz' + xyz$

29. The minimum number of D flip-flops needed to design a mod-150 counter is

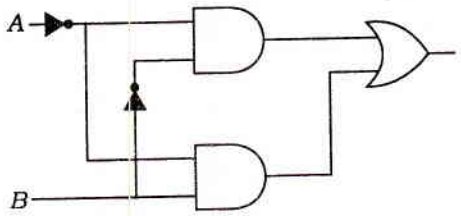
(a) 128

(b) 7

(c) 8

(d) 150

30. What is the Boolean expression for the circuit given below?



(a) $F(A, B) = A'B + A'B'$

(b) $F(A, B) = A \oplus B$

(c) $F(A, B) = A' + B'$

(d) $F(A, B) = A'B'$

PART—B

31. Time taken for addition of element in queue is

(a) $O(l)$

(b) $O(n)$

(c) $O(\log n)$

(d) None of the above

32. When inorder traversing a tree resulted $E\,A\,C\,K\,F\,H\,D\,B\,G$. The preorder traversal would return

(a) $F\,A\,E\,K\,C\,D\,B\,H\,G$

(b) $F\,A\,E\,K\,C\,D\,H\,G\,B$

(c) $E\,A\,F\,K\,H\,D\,C\,B\,G$

(d) $F\,E\,A\,K\,D\,C\,H\,B\,G$

33. If every node u in G is adjacent to every other node v in G, a graph is said to be

(a) isolated

(b) complete

(c) finite

(d) strongly connected

34. A hash function f defined as f (key) = key mod 7, with linear probing, inserts the keys 37, 38, 72, 48, 98, 11, 56 into a table. Then 11 will be stored in the location

(a) 3

(b) 4

(c) 5

(d) 6

35. A B-tree of order m has maximum of —— children.

(a) m

(b) $m+1$

(c) $m-1$

(d) $m/2$

36. The complexity of merge sort algorithm is

(a) $O(n)$ (b) $O(\log n)$

(c) $O(n^2)$ (d) $O(n \log n)$

37. A graph with every node u connected with every other node v is a

i. bipartite graph

ii. connected graph

iii. complete graph

Choose the correct statement(s) from the above.

(a) only i

(b) Both i and ii

(c) Both ii and iii

(d) All i, ii and iii

38. Which of the given options provides the increasing order of asymptotic complexity of functions f_1, f_2, f_3 and f_4 for $n > 2$?

$$f_1(n) = 2^n$$

$$f_2(n) = n^{\frac{1}{2}}$$

$$f_3(n) = n \log n$$

$$f_4(n) = n^{\log n}$$

(a) f_3, f_2, f_4, f_1 (b) f_3, f_2, f_1, f_4

(c) f_2, f_3, f_1, f_4 (d) f_2, f_3, f_4, f_1

39. Let P be a shortest path from some vertex s to some other vertex t in a graph. If the weight of each edge in the graph is increased by one

(a) P will still be a shortest path from s to t

(b) P may or may not be a shortest path from s to t

(c) P will never be a shortest path from s to t

(d) None of the above

40. Consider the following two functions :

$$f(n) = n^3, \quad \text{if } 0 \le n < 10000$$
$$= n^2, \quad \text{if } n \ge 10000$$
$$g(n) = n, \quad \text{if } 0 \le n < 100$$
$$= n^2 + 5n, \quad \text{if } n \ge 100$$

Which of the following is true?

(a) $f(n)$ is of $O(n^3)$

(b) $g(n)$ is $O(n)$

(c) $O(f(n))$ is same as $O(g(n))$

(d) None of the above

41. $\sum_{k=1}^{n} O(n^2)$, where $O(n)$ stands for order of n, is

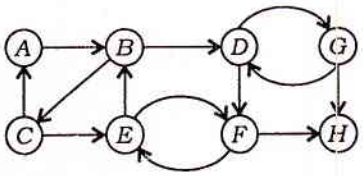
(a) $O(n^2 \log n)$

(b) $O(n^2)$

(c) $O(n^3)$

(d) None of the above

42. The strongly connected components of the graph



are

(a) $\{\{ABDGCEF\}, \{H\}\}$

(b) $\{\{ABCE\}\{DG\}, \{FH\}\}$

(c) $\{\{ABC\}, \{DG\}, \{EF\}, \{H\}\}$

(d) None of the above

43. Which of the following is the Huffman code for the characters $\{a, b, c, d, e, f\}$ having the following frequencies?

c	a	b	c	d	e	f
$f(c)$	45	13	12	16	9	5

(a) 0, 101, 100, 111, 1101, 1100

(b) 0, 10, 110, 1110, 11110, 11111

(c) 11, 10, 01, 001, 0001, 0000

(d) 11, 10, 011, 010, 001, 000

44. Measurements of a certain system have shown that the average process runs for a time T before blocking for I/O. A process switch requires time S, which is effectively waste (overhead). Consider a round-robin scheduler with quantum Q. Assuming there is no variation among the processes, if $Q < T$, then the CPU efficiency is

(a) $T/(S+T)$

(b) $T/(T+S\lceil T/Q\rceil)$

(c) $Q/(Q+S)$

(d) 0·5

45. An 'aging algorithm' is being used to estimate the mean value of a sequence of observations X_n. Suppose that the distribution of the X_n's does not actually vary over time, so that they are independent random variables, identically distributed with mean μ and variance σ^2. Let Y_n be the nth estimate computed by the aging algorithm, so $Y_n = \alpha X_n + (1-\alpha)Y_{n-1}$ for large n. Then, the expected value of Y_n and the variance of Y_n are

(a) μ and $\sigma^2\alpha/(2-\alpha)$

(b) μ and $\sigma^2\alpha/(1-\alpha)$

(c) μ and σ^2

(d) μ and $\sigma^2\alpha^2$

46. A batch-processing system needs a module to manage allocation of N line printers, identified by integers in the range 0 up to $N-1$. It must provide functions *AllocPrinter and FreePrinter*. Which of the following is a reasonable requirement?

(a) *AllocPrinter* allocates a printer and returns its number. Printers can be allocated to any client, since it is very unlikely that two clients will request the same printer at the same instant

(b) *AllocPrinter* allocates a printer and returns its number; this printer is not allocated to any other client for some fixed period of time, after which the number is passed to *FreePrinter*

(c) *AllocPrinter* allocates a printer and returns its number; this printer is not allocated to any other client until the same number is passed as an argument to *FreePrinter*

(d) *AllocPrinter* simply allocates a printer, *FreePrinter* simply frees a printer

47. The message passing scheme for synchronization can be used only if the processes are

(a) not aware of each other

(b) indirectly aware of each other

(c) directly aware of each other

(d) None of the above

48. The CPU scheduling parameter throughput refers to

(a) keeping CPU as busy as possible

(b) total time spent by processes in waiting state

(c) amount of time it takes for processes to start responding

(d) number of processes completed per unit time

49. If the baud rate is 400 for a 4-phase-shift keying (4-PSK) signal, the bit rate is

(a) 100 bps

(b) 400 bps

(c) 800 bps

(d) 1600 bps

50. If we want to combine 20 voice-grade signals (each with 4 kHz) with a guard band of 1 kHz between them to prevent interference, how much bandwidth do we need (in kHz)?

(a) 81

(b) 101

(c) 99

(d) 100

51. In the CSMA/CD protocol, what condition on the transmission delay T_{trans} and the propagation delay T_{prop} has to be satisfied to guarantee that a node always detects a collision?

(a) $T_{trans} > T_{prop}$

(b) $T_{trans} > 2T_{prop}$

(c) $T_{trans} < T_{prop}$

(d) $2T_{trans} < T_{prop}$

52. If a class *B* network on the Internet has a subnet mask of 255.255.248.0, what is the maximum number of hosts per subnet?

(a) 1022

(b) 1023

(c) 2046

(d) 2047

53. Host *A* sends a TCP segment (Seq = 43, ACK = 103), to which host *B* replies with a TCP segment (Seq = 103, ACK = 57). The payload of the first TCP segment is

(a) 14 bytes long

(b) 43 bytes long

(c) 46 bytes long

(d) 57 bytes long

54. What is the minimum Hamming distance for the following set of four 6-bit code words?

000000 000111 111000 111111

(a) 2

(b) 3

(c) 4

(d) 5

55. ICMP (Internet Control Message Protocol) is used by

(a) ping to provide echo request/reply

(b) traceroute to measure the delay between the routers from a source to a destination

(c) host and routers to communicate network level information

(d) All of the above

56. You want to check if there is an assignment of TRUE and FALSE values to $N = 100$ Boolean variables that makes a formula F true. If a computer can check the truth value of F for any particular assignment in 1 picosecond (10^{-12} seconds), approximately how long will it take in the worst case to determine that there is no assignment of values to the N variables that can make formula F true?

(a) 100×10^{-12} seconds

(b) 10 seconds

(c) 10^{8} seconds

(d) 10^{18} seconds

57. The dataflow diagram

i. depicts relationships between data objects

ii. depicts functions that transform the data flow

iii. indicates how data are transformed by the system

iv. indicates system reactions to external events

Choose the correct statement(s) from the above.

(a) i, ii

(b) ii, iii

(c) i

(d) None of the above

58. Software deteriorates rather than wears out, because

i. software suffers from exposure to hostile environments

ii. defects are more likely to arise after software has been used often

iii. multiple change requests introduce errors in component interactions

iv. software spare parts become harder to order

Choose the correct statement(s) from the above.

(a) i

(b) ii, iii

(c) iii

(d) None of the above

59. The state transition diagram

i. depicts relationships between data objects

ii. depicts functions that transform the data flow

iii. indicates how data are transformed by the system

iv. indicates system reactions to external events

Choose the correct statement(s) from the above.

(a) i

(b) ii, iii

(c) iv

(d) None of the above

60. A relation is in Boyce-Codd Normal Form (BCNF) if every

(a) determinant is a candidate key

(b) key is atomic

(c) attribute is fully functional dependent on primary key

(d) attribute is independent on primary key

61. Indexes in DBMS are used to

(a) organize records and speedup retrieval

(b) speedup sorting of files

(c) sort the selected records on the desired attribute

(d) speedup joining of tables on selected attributes

62. Referential integrity dictates that the value of a

(a) primary key must appear in a foreign key of the related table

(b) foreign key must appear in a primary key of the related table

(c) primary key cannot appear in a foreign key of the related table

(d) foreign key cannot appear in a primary key of the related table

63. If $r(A, C)$ and $s(A, D)$ are any relations with the given attributes, then which of the following relational algebra expressions means the join of R and S?

(a) $\pi_{A,C,D}(\sigma_{r.A=s.A}(r \times s))$

(b) $\pi_{A,C,D}(\sigma_{s.A=r.A}(r \times s))$

(c) $\sigma_{A,C,D}(\pi_{r.A=s.A}(r \times s))$

(d) None of the above

64. Which of the following is not a characteristic of metadata?

(a) Includes user data

(b) Data that describes user data

(c) Stored in data dictionary

(d) Used while execution of DML commands

65. Which of the following is true about database transactions?

i. Execution of a transaction should be atomic

ii. Effects of a transaction persist even if the system crashes before it can be completed

iii. A transaction is either committed or aborted

iv. A transaction is sequence of logically related actions

Choose the correct statement(s) from the above.

(a) i, ii, iv

(b) i, ii, iii

(c) i, iii, iv

(d) All of the above

66. The most common addressing technique employed by a CPU is

(a) immediate

(b) direct

(c) indirect

(d) All of the above

67. Which of the following registers is used to keep track of address of the memory location where the next instruction is located?

(a) Memory address register

(b) Memory data register

(c) Instruction register

(d) Program counter register

68. The number of instructions needed to add n numbers and store the result in memory using only one address instructions is

(a) n

(b) $n+1$

(c) $n-1$

(d) independent of n

69. Which of the following need not necessarily be saved on a context switch between processes?

(a) General purpose register

(b) Translation look aside buffer

(c) Program counter

(d) All of the above

70. The sequence of events that happen during a typical fetch operation is

(a) PC > MAR > Memory > MDR > IR

(b) PC > Memory > MAR > IR > MDR

(c) PC > IR > Memory

(d) Memory > PC > MAR > IR > MDR

★ ★ ★