50004

Test Centre : _____

Roll No. : _____

Name of the Candidate : _____

S A U

Entrance Test for M.Phil./Ph.D. (Computer Science), 2016

[PROGRAMME CODE : PCS]

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.**

/12-**A**

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.**
   Example :

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

   A or B

   ●
   ⒝

   Write Programme Code

MEC	O	MAM	O	PCS	●
MSO	O	MLS	O	PBT	O
MIR	O	PEC	O	PAM	O
MCS	O	PSO	O	PLS	O
MBT	O	PIR	O		

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 <u>ONLY ONE CIRCLE</u> for each question as shown below in the example :
   Example :

Wrong	Wrong	Wrong	Wrong	Correct
● ⒝ ⒞ ●	ⓧ ⒝ ⒞ ⒟	ⓧ ⒝ ⒞ ⓧ	⊙ ⒝ ⒞ ●	⒜ ⒝ ⒞ ●

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. **A wrong answer will lead to the deduction of one-fourth of the marks assigned to that question.**

10. Write your six-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

1	3	5	7	2	0
●	①	①	①	①	①
②	②	②	②	●	②
③	●	③	③	③	③
④	④	④	④	④	④
⑤	⑤	●	⑤	⑤	⑤
⑥	⑥	⑥	⑥	⑥	⑥
⑦	⑦	⑦	●	⑦	⑦
⑧	⑧	⑧	⑧	⑧	⑧
⑨	⑨	⑨	⑨	⑨	⑨
⓪	⓪	⓪	⓪	⓪	●

PART—A

1. If X and Y are finite sets, then there exists a bijection between the two sets X and Y if and only if

   (a) X and Y have more than two elements

   (b) X and Y have the same number of elements

   (c) the number of elements in X is greater than the number of elements in Y

   (d) the number of elements in Y is greater than the number of elements in X

2. The relation given by the following graph
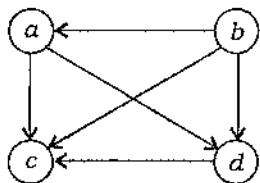
   is

   (a) symmetric

   (b) transitive

   (c) anti-symmetric

   (d) All of the above

3. The principal disjunctive normal form of $\neg P \vee Q$ is

   (a) $(P \wedge \neg Q) \vee (\neg P \wedge \neg Q) \vee (P \wedge Q)$

   (b) $(\neg P \wedge Q) \vee (P \wedge \neg Q) \vee (P \wedge Q)$

   (c) $(\neg P \wedge Q) \vee (\neg P \wedge \neg Q) \vee (P \wedge Q)$

   (d) $(\neg P \wedge Q) \vee (\neg P \wedge Q) \vee (P \wedge Q)$

4. How many words containing 3 consonants and 2 vowels can be formed from 7 consonants and 4 vowels, if all letters are different?

   (a) $^{11}C_5$

   (b) $^{7}C_3 \times {}^{4}C_2$

   (c) $^{28}C_6$

   (d) $^{7}C_3 \times {}^{4}C_2 \times 5!$

5. The solution of the recurrence relation $a_n = 3a_{n-1}$ with $a_0 = 2$ is

(a) $a_n = 2 \times 3^n$

(b) $a_n = 3 \times 2^n$

(c) $a_n = 2 + 3^n$

(d) $a_n = 3 + 2^n$

6. If $f(n) = 4f(n/2) + n + 2$ and $f(1) = 2$, then the value of $f(8)$ is

(a)   12

(b)   54

(c)   66

(d)   226

7. Let E and F be two events such that $P(E) = 0.3$ and $P(E \cup F) = 0.8$. If E and F are independent events, then $P(F)$ is

(a) $\dfrac{3}{7}$

(b) $\dfrac{4}{7}$

(c) $\dfrac{5}{7}$

(d) $\dfrac{6}{7}$

8. A random variable X has the following probability mass function :

X	0	1	2
$P(X = x)$	0.2	0.5	0.3

Then variance (X) equals

(a)   1.7

(b)   0.49

(c)   1.21

(d)   None of the above

9. If $X \sim N(\mu, \sigma^2)$, where $\mu = 100$ and $\sigma^2 = 16$, and if $Y = 3X + 4$, then

(a) $E(Y) = 304$, $V(Y) = 48$

(b) $E(Y) = 316$, $V(Y) = 52$

(c) $E(Y) = 304$, $V(Y) = 144$

(d) $E(Y) = 308$, $V(Y) = 148$

10. If X be a random variable having uniform distribution over $[-1, 1]$ and $Y = X^2$, then $P[Y \leq 1/4]$ equals

(a) $1/4$

(b) $1/2$

(c) 1

(d) 0

11. The linear programming problem

$$\text{Maximize} \quad Z = 8x_1 + 4x_2$$
$$\text{subject to}$$
$$x_1 + x_2 \leq 8$$
$$2x_1 + x_2 \leq 10$$
$$x_1 \geq 0, \ x_2 \geq 0$$

(a) is unbounded

(b) has unique optimal solution

(c) is infeasible

(d) has infinitely many optimal solutions

12. For the linear programming problem

$$\text{Maximize} \quad Z = x_1 + 2x_2 - x_3$$
$$\text{subject to}$$
$$2x_1 + x_2 + x_3 = 4$$
$$x_1 \geq 0, \ x_2 \geq 0, \ x_3 \geq 0$$

the point $(\bar{x}_1 = 1, \ \bar{x}_2 = 0, \ \bar{x}_3 = 2)$ is

(a) a basic feasible solution

(b) a feasible solution which is not a basic solution

(c) an optimal solution

(d) not a feasible solution

13. If the following linear programming problem be solved by either the two-phase method or big-M method

$$\text{Minimize} \quad Z = 2x_1 + x_2$$
$$\text{subject to}$$
$$3x_1 + x_2 = 3$$
$$4x_1 + 3x_2 \geq 6$$
$$x_1 + 2x_2 \leq 3$$
$$x_1 \geq 0, \ x_2 \geq 0$$

then the required number of artificial variables to be introduced is

(a) 3   (b) 2

(c) 1   (d) 0

14. Let it be known that $(\bar{x}_1 = 8, \ \bar{x}_2 = 0, \ \bar{x}_3 = 8)$ is optimal to the following linear programming problem :

$$\text{Maximize} \quad Z = 2x_1 + x_2 - x_3$$
$$\text{subject to}$$
$$x_1 + 2x_2 + x_3 \leq 8$$
$$-x_1 + x_2 - 2x_3 \leq 4$$
$$x_1 \geq 0, \ x_2 \geq 0, \ x_3 \geq 0$$

Let $(\bar{w}_1, \ \bar{w}_2)$ be optimal to the dual of the given LPP. Then

(a) $\bar{w}_1 < 0, \ \bar{w}_2 > 0$

(b) $\bar{w}_1 \geq 0, \ \bar{w}_2 < 0$

(c) $\bar{w}_1 < 0, \ \bar{w}_2 < 0$

(d) $\bar{w}_1 \geq 0, \ \bar{w}_2 = 0$

15. If $\vec{a}, \ \vec{b}$ and $\vec{c}$ are three linearly independent vectors, then

$$\frac{\{(\vec{a} + 2\vec{b}) \times (2\vec{b} + \vec{c})\} \cdot (5\vec{c} + \vec{a})}{\vec{a} \cdot (\vec{b} \times \vec{c})}$$

is equal to

(a) 10   (b) 14

(c) 18   (d) 12

16. If G is the centroid of triangle ABC such that $\overrightarrow{GB}$ and $\overrightarrow{GC}$ are inclined at an obtuse angle, then

(a) $5c^2 > a^2 + b^2$

(b) $5a^2 > b^2 + c^2$

(c) $5b^2 > c^2 + a^2$

(d) None of the above

17. If each of the vertices of a triangle has integral coordinates, then the triangle will not be

(a) right-angled

(b) equilateral

(c) isosceles

(d) Any of the above

18. If the lines represented by $x^2 + 2\beta xy + 2y^2 = 0$ and the lines represented by $(1+\beta)x^2 - 8xy + y^2 = 0$ are equally inclined, then

(a) β is a real number

(b) $\beta > 2$

(c) $\beta = \pm 2$

(d) $\beta < -2$

19. If $P = \begin{bmatrix} 1 & 0 & 2 \\ 5 & 1 & x \\ 1 & 1 & 1 \end{bmatrix}$ is a singular matrix, then x is equal to

(a) 3   (b) 5

(c) 9   (d) 11

20. Let P be a (3×3) real matrix having eigenvalues as -2, 3 and 1. Then $\det(P)$ equals

(a) 6   (b) 2

(c) -6 (d) 12

21. Let $P = \begin{bmatrix} a & 2 & 3 \\ -2 & 0 & b \\ c & 4 & d \end{bmatrix}$ be real skew-symmetric. Then

(a) $a = 1$, $b = 4$, $c = 3$, $d = 1$

(b) $a = 0$, $b = -4$, $c = -3$, $d = 0$

(c) $a = 0$, $b = -4$, $c = 3$, $d = 0$

(d) $a = -1$, $b = -4$, $c = -3$, $d = -1$

22. Consider the system of linear equations

$$x + 2y + z = 3$$
$$2x + 3y + z = 3$$
$$3x + 5y + 2z = 1$$

Then the system has

(a) a unique solution

(b) infinitely many solutions

(c) exactly three solutions

(d) no solution

23. What is the output of the following function, if we call 'fn(3,4)'?

```
int fn(int a, int b) {
  if (b= =0)
    return b;
  else
    return (a*fn(a, b-1));
}
```

(a) 0

(b) 64

(c) 81

(d) None of the above

24. If y is of integer type, then the expressions $3 \times (y-8) \div 9$ and $(y-8) \div 9 \times 3$

    (a)   must yield the same value

    (b)   must yield different values

    (c)   may or may not yield the same value

    (d)   None of the above

25. Which one is the output of the following C code?

```
# include <stdio.h>
main( ) {
   int ary[4] = {1, 2, 3, 4};
   int *p = ary + 3;
   printf("%d\n", p[-2]);
}
```

    (a)   1

    (b)   2

    (c)   3

    (d)   Compilation error

26. What is the output of a two-dimensional square matrix A[n][n], when passed to the following function?

```
void mat (int A[ ][n]) {
   int i, j, tmp;
   for (i = 0; i < n; i++)
     for (j = 0; j < n; j++) {
       tmp = A[i][j] + 5;
       A[i][j] = A[j][i];
       A[j][i] = tmp - 5;
     }
}
```

    (a)   The same matrix A

    (b)   Transpose of matrix A

    (c)   Adding 5 to the upper diagonal elements and subtracting 5 from lower diagonal elements of A

    (d)   None of the above

27. Which one of the following is true?

(a) $(110110.110)_2 = (36.D0)_{16}$

(b) $(110110.110)_2 = (35.C1)_{16}$

(c) $(110110.110)_2 = (37.B0)_{16}$

(d) $(110110.110)_2 = (36.C0)_{16}$

28. Which one of the following is true?

(a) $(2006.50)_{10} = (7E6.80)_{16}$

(b) $(2006.50)_{10} = (7D6.80)_{16}$

(c) $(2006.50)_{10} = (7E6.08)_{16}$

(d) $(2006.50)_{10} = (7C6.80)_{16}$

29. Which of the following ASCII codes is false?

(a) $B = 1000010$

(b) $b = 1100010$

(c) $P = 1010000$

(d) $p = 1010000$

30. Which of the following is a symbolic representation of machine instructions?

(a) High-level language

(b) Assembly language

(c) Machine language

(d) Both (b) and (c)

PART—B

31. The memory address of the fifth element of an array can be calculated by the formula

    (a) LOC(Array[5]) = Base(Array) + w(5-lower bound), where w is the number of words per memory cell for the array

    (b) LOC(Array[5]) = Base(Array[5]) + (5-lower bound), where w is the number of words per memory cell for the array

    (c) LOC(Array[5]) = Base(Array[4]) +(5-upper bound), where w is the number of words per memory cell for the array

    (d) None of the above

32. Which of the following statements is false?

    (a) Arrays are dense lists and static data structures.

    (b) Data elements in a linked list need not be stored in adjacent spaces in the memory.

    (c) Pointers store the next data element of a list.

    (d) Linked lists are collections of the nodes that contain information and next pointer.

33. When inorder traversing a tree resulted EACKFHDBG, the preorder traversal would return

    (a) FAEKCDBHG

    (b) FAEKCDHGB

    (c) EAFKHDCBG

    (d) FEAKDCHBG

34. The minimum number of nodes in a binary tree of depth d (root at level 0) is

    (a) $2 \wedge d - 1$

    (b) $2 \wedge (d + 1) - 1$

    (c) $d + 1$

    (d) d

35. A hash function f defined as $f(\text{key}) = \text{key} \bmod 13$, with linear probing is used to insert keys 55, 58, 68, 91, 27, 145. What will be the location of 79?

   (a) 1

   (b) 2

   (c) 3

   (d) 5

36. A machine needs a minimum of 100 s to sort 1000 names by quicksort. The minimum time needed to sort 100 names will be approximately

   (a) 50·2 s

   (b) 6·7 s

   (c) 11·2 s

   (d) 72·4 s

37. Which of the following algorithms solves all pairs shortest path problem?

   (a) Dijkstra's algorithm

   (b) Floyd's algorithm

   (c) Prim's algorithm

   (d) Warshall's algorithm

38. Which of the following methods is taking overcharge for some operations in amortized analysis?

   (a) Aggregate method

   (b) Accounting method

   (c) Potential method

   (d) Both (a) and (c)

39. The time complexities of the normal quicksort and randomized quick sort algorithms in the worst case are

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

  (b) $O(n^2)$ and $O(n^2)$

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

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

40. The number of comparisons required by binary search of 1000000 elements is

  (a)   15

  (b)   20

  (c)   25

  (d)   30

41. Which of the following page replacement algorithms may throw important pages for bringing the required page in the memory?

  (a)   LRU

  (b)   NRU

  (c)   FIFO

  (d)   All of the above

42. Which of the following is not contained in Process Control Block (PCB)?

  (a)   Process state

  (b)   CPU scheduling information

  (c)   Memory management information

  (d)   Process execution time

43. Which of the following statements is false with regard to Banker's algorithm?

  (a)   It can prevent deadlocks.

  (b)   It needs a priori information about maximum resource usage, hence is impractical.

  (c)   It breaks deadlock by killing some processes.

  (d)   All of the above

44. In best-fit memory allocation, the _____ block that can satisfy a memory request is selected.

    (a) smallest

    (b) largest

    (c) first

    (d) last

45. Which of the following is a valid ls command option in UNIX to know the inode number of a file?

    (a) -inode

    (b) -num

    (c) -i

    (d) -in

46. In UNIX, which of the following symbols is used in command line to run a process in background?

    (a) &

    (b) |

    (c) *

    (d) #

47. The additional code written for module testing is known as

    (a) stub

    (b) driver

    (c) mutant

    (d) All of the above

48. Which of the following statements is true?

(a) Mutation testing is a fault-based testing.

(b) Mutation testing is a functional testing.

(c) Mutation testing is nothing but fault checking.

(d) All of the above

49. COCOMO stands for

(a) Cost Constructive Model

(b) Complementary Cost Model

(c) Common Cost Model

(d) Constructive Cost Model

50. Loop testing is

(a) white-box testing

(b) black-box testing

(c) Both (a) and (b)

(d) None of the above

51. A TCP message consisting of 2100 bytes is passed to IP for delivery across two networks. The first network can carry a maximum payload of 1200 bytes per frame and the second network can carry a maximum payload of 400 bytes per frame, excluding network overhead. Assume that IP overhead per packet is 20 bytes. What is the total IP overhead in the second network for this transmission?

(a) 40 bytes

(b) 80 bytes

(c) 120 bytes

(d) 160 bytes

52. Host A (on TCP/IPv4 network X) sends an IP datagram to host B (also on TCP/IPv4 network Y). Assume that no error occurs during the transmission. When the datagram reaches B, which of the following field(s) in the IP header may be different from that of the original datagram?

    1.   TTL

    2.   Checksum

    3.   Fragment offset

    (a)   1 only

    (b)   1 and 2 only

    (c)   2 and 3 only

    (d)   1, 2 and 3

53. How many pairs of Cat-5 UTP are used in 1000 Base-T Ethernet standard?

    (a)   1

    (b)   2

    (c)   4

    (d)   8

54. In Ethernet when 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

55. Four bits are used for packet sequence numbering in a sliding window protocol used in a computer network. What is the maximum window size?

    (a)   4

    (b)   8

    (c)   15

    (d)   16

56. Hardware that calculates a CRC uses two simple components. They are

(a) AND unit with XOR unit

(b) shift register with AND unit

(c) shift register with shift XOR unit

(d) shift register with XOR unit

57. Which of the following statements is false?

(a) HTTP runs over TCP.

(b) HTTP describes the structure of web pages.

(c) HTTP allows information to be stored in a URL.

(d) HTTP can be used to test the validity of hypertext links.

58. The following functional dependencies hold for relations $R(A, B, C)$ and $S(B, D, E)$:

$$B \rightarrow A$$
$$A \rightarrow C$$

The relation R contains 200 tuples and relation S contains 100 tuples. What is the maximum number of tuples possible in the natural join $R \bowtie S$?

(a) 100

(b) 200

(c) 300

(d) 2000

59. Assume transaction A holds a shared lock R. If transaction B also requests for a shared lock in R, then it will

(a) result in a deadlock situation

(b) immediately be granted

(c) immediately be rejected

(d) be granted as soon as it is released by A

**60.** Consider the following set of functional dependencies on the scheme (A, B, C) :

$$A \to BC$$
$$B \to C$$
$$A \to B$$
$$AB \to C$$

The canonical cover of this set is

(a) $A \to BC$ and $B \to C$

(b) $A \to BC$ and $AB \to C$

(c) $A \to BC$ and $A \to B$

(d) $A \to B$ and $B \to C$

61. Given the basis ER and relational models, which of the following is incorrect?

(a) An attribute of an entity can have more than one value

(b) An attribute of an entity can be composite

(c) In a row of relational table, an attribute can have more than one value

(d) In a row of relational table, an attribute can have exactly one value

62. Suppose $R_1(A, B)$ and $R_2(C, D)$ are two relation schemas. If r_1 and r_2 be the corresponding relation instances, B is a foreign key that refers to C in R_2 and if data in r_1 and r_2 satisfy referential integrity constraints, which of the following is always true?

(a) $\prod_B(r_1) - \prod_C(r_2) = 0$

(b) $\prod_C(r_2) - \prod_B(r_1) = 0$

(c) $\prod_B(r_1) = \prod_C(r_2)$

(d) $\prod_B(r_1) - \prod_C(r_2) \neq 0$

63. This problem deals with translating from C to MIPS. Assume that the variables f, g, h, i, and j are assigned to registers $\$s_0$, $\$s_1$, $\$s_2$, $\$s_3$ and $\$s_4$ respectively. Also assume that the base addresses of arrays A and B are in registers $\$s_6$ and $\$s_7$ respectively. For the C statement, $f = -g + h + B[1]$, what is the minimum number of MIPS assembly instructions that are needed to perform the C statement?

(a) 3

(b) 4

(c) 5

(d) 2

64. Which one of the following is not considered to be a classic component of a computer?

   (a) Processor

   (b) Memory

   (c) Instruction set architecture

   (d) I/O

65. The number of tasks completed by a processor per unit time is called

   (a) completed task set

   (b) bandwidth

   (c) latency

   (d) All of the above

66. If we divide the CPU clock cycles required for a program by the clock rate, then we get

   (a) execution time

   (b) processing time

   (c) CPU time

   (d) All of the above

67. The 32-bit MIPS double precision floating point representation is

$$x = (-1)^S \times (1 + \text{Fraction}) \times 2^{(\text{Exponent} - \text{Bias})}$$

   How many bits are used to accommodate 'Exponent'?

   (a) 52 bits

   (b) 23 bits

   (c) 11 bits

   (d) 8 bits

68. If the following is an optimized divider circuit in 32-bit MIPS, then which of the following will be true?
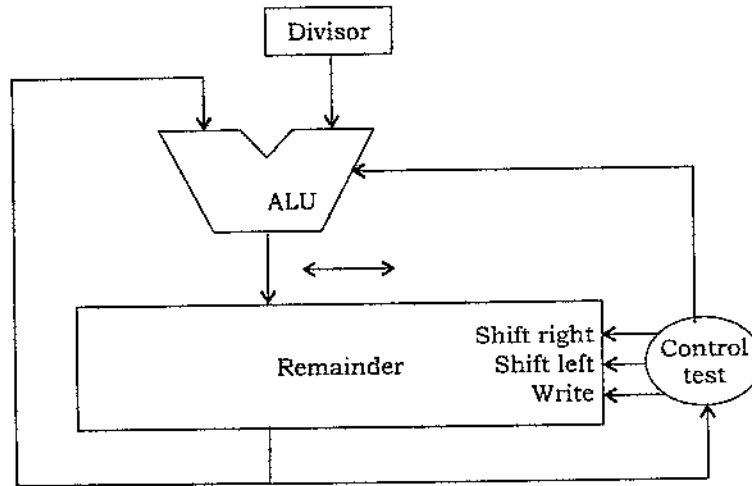
(a) Divisor is of 32 bits, ALU is of 64 bits and Remainder is of 32 bits

(b) Divisor is of 32 bits, ALU is of 64 bits and Remainder is of 64 bits

(c) Divisor is of 32 bits, ALU is of 32 bits and Remainder is of 32 bits

(d) Divisor is of 32 bits, ALU is of 32 bits and Remainder is of 64 bits

69. Which of the following is not a solution for control hazard in a pipelined datapath?

(a) Branch prediction

(b) Stalling

(c) Bypassing

(d) Both (a) and (c)

70. Which of the following is the slowest instruction in MIPS?

(a) add

(b) lw

(c) sw

(d) bne