12

QUESTION PAPER
SERIES CODE

A

Centre Name : _____

Roll No. : _____

Name of Candidate : _____

S A U

Entrance Test for M.Phil./Ph.D. (Computer Science), 2014

[PROGRAMME CODE : PCS]

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, Roll Number and Centre Name in the space provided for the purpose on the top of this Question Paper and in 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) Symbols have their usual meanings.

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

(vii) Part—A and Part—B (Multiple Choice) questions 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. Mobile Phones are **NOT** allowed.

(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'
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 and darken appropriate circle.	Write Programme Code out of 14 codes given and darken 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. There will be <u>no negative marking</u> in evaluation.

10. Write your six digits Roll Number in small boxes provided for the purpose; and also darken 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
ⓞ	ⓞ	ⓞ	ⓞ	ⓞ	●

PART—A

1. Let $A = \{15, 16, 17, 18, 0\}$. Then the number of subsets of A containing 15 and 0 is

   (a) 1

   (b) 2

   (c) 4

   (d) 8

2. In a group of 50 persons, everyone takes either tea or coffee. If 35 persons take tea and 25 persons take coffee, then the number of persons who take tea only is

   (a) 10

   (b) 25

   (c) 35

   (d) 40

3. The relation $\{(1, 2), (1, 3), (3, 1), (1, 1), (3, 3), (3, 2), (1, 4), (4, 2), (3, 4)\}$ is

   (a) reflexive

   (b) transitive

   (c) symmetric

   (d) antisymmetric

4. Identify a function which is one-one and onto

   (a) $f : \mathbb{N} \to \mathbb{N}$ given by $f(x) = 2x$

   (b) $f : \mathbb{R} \to \mathbb{R}$ given by $f(x) = 2x$

   (c) $f : \mathbb{R} \to \mathbb{R}$ given by $f(x) = x^2$

   (d) $f : \mathbb{N} \to \mathbb{N}$ given by $f(x) = x^2$

5. Which of the following propositions is a tautology?

(a) $(p \vee q) \rightarrow p$

(b) $p \vee (q \rightarrow p)$

(c) $p \vee (p \rightarrow q)$

(d) $p \rightarrow (p \rightarrow q)$

6. In how many different ways can the letters of the word 'LEADING' be arranged in such a way that the vowels always come together?

(a) 360

(b) 480

(c) 720

(d) 5040

7. The probability of a shooter hitting a target is $\frac{1}{2}$. How many minimum numbers of times must he fire so that the probability of hitting the target at least once is more than 99 percent?

(a) 4

(b) 5

(c) 6

(d) 7

8. 10 is the mean of a set of 7 observations and 5 is the mean of a set of 3 observations. The mean of a combined set is given by

(a) 8·5

(b) 10

(c) 15

(d) 7·5

9. A continuous random variable X has a probability density function

$$f(x) = \begin{cases} x^2, & 0 \le x \le 1 \\ 0, & \text{otherwise} \end{cases}$$

Find a such that $P(X \le a) = P(X > a)$

(a) $a = \dfrac{1}{2}$

(b) $a = \dfrac{1}{\sqrt{2}}$

(c) $a = \left(\dfrac{1}{2}\right)^{\frac{1}{3}}$

(d) None of the above

10. The binary operation $*$ on the set Q of rational numbers defined by $a * b = (a - b)^2$, $\forall\, a, b \in Q$ is

(a) both associative and commutative

(b) associative but not commutative

(c) commutative but not associative

(d) neither associative nor commutative

11. The derivative of $\cos\left(\dfrac{\pi}{2}\log x\right)$ at $x = e$ is

(a) $-\dfrac{\pi}{2e}$

(b) $\dfrac{\pi}{2e}$

(c) $-\dfrac{1}{2e}$

(d) $\dfrac{1}{2e}$

12. What is the value of the following integral?

$$\int_0^1 \left(\int_x^1 \frac{e^t}{t}\, dt \right) dx$$

(a) $-1 - e$

(b) $1 - e$

(c) $e - 1$

(d) $e + 1$

13. Which of the following satisfies the first-order first-degree differential equation?

$$\frac{dy}{dx} = x^2 e^{-y} + e^{x-y}$$

(a) $3e^y = x^3 + 3e^x + c$

(b) $3e^y = x^3 + 3e^{4x} + c$

(c) $3e^y = x^3 + 3e^{-x} + c$

(d) $3e^y = x^{-3} + 3e^x + c$

14. The integrating factor of the linear differential equation

$$(1 - x^2)\frac{dy}{dx} + 2xy - x\sqrt{1 - x^2} = 0$$

is given by

(a) $\dfrac{1}{1 + x^2}$

(b) $\dfrac{1}{1 + y^2}$

(c) $\dfrac{1}{1 - x^2}$

(d) $\dfrac{1}{1 + xy}$

15. For the differential equation $\dfrac{dy}{dx} = y(m - y)$, $\lim\limits_{x \to \infty} y$ is

(a) 0

(b) $m/2$

(c) m

(d) ∞

16. If **A** and **B** are any two vectors, then $|\mathbf{A} \times \mathbf{B}|^2 + |\mathbf{A} \cdot \mathbf{B}|^2$ is equal to

(a) $|\mathbf{A}|^2 |\mathbf{B}|^2$

(b) 0

(c) $2|\mathbf{A}|^2 |\mathbf{B}|^2$

(d) $2|\mathbf{A}| |\mathbf{B}|$

17. The projection of $\mathbf{A} = \hat{i} - 2\hat{j} + 3\hat{k}$ on the vector $\mathbf{B} = \hat{i} + 2\hat{j} + 2\hat{k}$ is

(a) 0

(b) 1

(c) 2

(d) −1

18. Which of the following statements is correct?

(a) A linear system with more equations than unknowns cannot have solutions

(b) A linear system can only have an infinite number of solutions if there are more variables than equations

(c) It is possible to construct a linear system with exactly 5 different solutions

(d) Suppose A is $n \times n$, x is $n \times 1$ and $Ax = 0$ has only the trivial solution. Then $Ax = b$ has solutions for any $n \times 1$ vector b

19. The following system of equations
$$x + 2y = 3, \quad \alpha x + \beta y = -9$$
has infinite number of solutions for

(a) $\alpha = -3$, $\beta = 6$

(b) $\alpha = -3$, $\beta = -6$

(c) $\alpha = 3$, $\beta = -6$

(d) $\alpha = 3$, $\beta = 6$

20. If k is a scalar and A is a square matrix of order n, then $kA(\text{adj } kA) =$

(a) $k^n |A| I_n$

(b) $k^{n-2} |A| I_n$

(c) $k^{n-1} |A| I_n$

(d) None of the above

21. Consider the following recursive functions :

```
int f1(int a, int b)
{
if(a == b)
return b;
else
return a + f2(a - 1, b);
}

int f2(int p, int q)
{
if(p < q)
return p + q;
else
return p + f1(p - 2, q);
}
```

What is the output if we call f1(5, 3)?

(a)   6

(b)   7

(c)   12

(d)   15

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

```
# include<stdio.h>
# define PRO(x) x*x
main( )
{
int i = 3, j, k;
j = PRO(i++);
k = PRO(++i);
printf("%d, %d", j, k);
}
```

(a)   16, 9

(b)   9, 16

(c)   16, 16

(d)   None of the above

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

```
# include<stdio.h>
main( )
{
int a = 36, b = 9;
printf("%d", a >> a/b- 2);
}
```

(a) 9

(b) 7

(c) 5

(d) None of the above

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

```
# include<stdio.h>
main( )
{
int a = 2;
switch(a)
 {
case 1:
printf("goodbye"); break;
case 2:
a--; continue;
case 3:
printf("bye");
 }
}
```

(a) goodbye

(b) bye

(c) goodbyebye

(d) Error

25. Consider the following code fragment :

int test[3][2][2] = {1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12};

What is the value of test[2][1][0]?

(a) 5

(b) 7

(c) 9

(d) 11

26. The following K-map represents which Boolean function?

WX↓ YZ→	00	01	11	10
00	1	1		1
01	1	1	1	
11			1	
10			1	

(a) $F(W, X, Y, Z) = WX + X'Y$

(b) $F(W, X, Y, Z) = WYZ + W'Y' + W'X'Z' + XYZ'$

(c) $F(W, X, Y, Z) = WYZ + W'Y' + W'X'Z' + W'XZ$

(d) None of the above

27. X is normally distributed random variable with mean -5 and variance 10. The expected value of $Y = e^X$ is

(a) 1

(b) e

(c) e^5

(d) None of the above

28. The Boolean expression $(xy + z)(y + xz)$ can be expressed in its canonical form as

(a) $\Sigma(3, 4, 5, 7)$

(b) $\Sigma(0, 2, 4, 7)$

(c) $\Pi(0, 4, 5, 7)$

(d) $\Pi(0, 1, 2, 4)$

29. Which of the following is false?

(a) $x + xy = x$

(b) $x + yz = (x + y)(x + z)$

(c) $(xy)' = (x + y)'$

(d) None of the above

30. Which of the following is not a sequential circuit?

(a) a D flip-flop

(b) a D latch

(c) a ring counter

(d) a decoder

PART—B

31. 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 of the above

32. Which of the given options provides the increasing order of asymptotic complexity of functions $f1$, $f2$, $f3$ and $f4$ for $n > 2$?

$$f1(n) = 2^n$$
$$f2(n) = n^{(1/2)}$$
$$f3(n) = n\log n$$
$$f4(n) = n^{\log n}$$

    (a) $f3, f2, f4, f1$
    (b) $f3, f2, f1, f4$
    (c) $f2, f3, f1, f4$
    (d) $f2, f3, f4, f1$

33. The number of null links (absent children of nodes) in a complete binary tree of n nodes is

    (a) $2n$
    (b) $n/2$
    (c) $n + 1$
    (d) $\log(n)$

34. The number of edges in a complete graph with n vertices is

    (a) $n(n + 1)/2$
    (b) $n(n - 1)/2$
    (c) $n - 1$
    (d) n^2

35. Linked list implementation of matrices gives no memory advantage over the normal array representation when

(a) most of the entries are positive

(b) most of the entries are negative

(c) most of the entries are non-zero

(d) most of the entries are zero

36. If you place m items in a hash table with an array size of s, what is the load factor?

(a) $s + m$

(b) $s - m$

(c) $m * s$

(d) m / s

37. Which of the following is an application of a binary search tree?

(a) Creating index structures for files

(b) Evaluating a postfix expression

(c) Both (a) and (b)

(d) None of the above

38. Which of the following cannot be expressed as a primitive recursive function?

(a) $f1(x, y) = x + y$

(b) $f2(x, y + 1) = f2(x - 1, f2(x, y))$

(c) $f3(x, y) = x * y$

(d) $f4(x) = 2x$

39. Consider $f(x) = floor(x)$ and $g(x) = ceiling(x)$. Which of the following is true?

(a) $f(x) < g(x)$

(b) $f(x) > g(x)$

(c) $f(x) \geq g(x)$

(d) $f(x) \leq g(x)$

40. Consider two program fragments P_1 with time complexity $T(1) = O(f(n))$ and P_2 with time complexity $T(2) = O(g(n))$. The time complexity of P_1 followed by P_2 will be

(a) $O(f(n) \cdot g(n))$

(b) $O(\min(f(n), g(n)))$

(c) $O(\max(f(n), g(n)))$

(d) None of the above

41. Which of the following cannot be an outcome of DFS on the given graph?
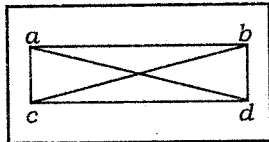
(a) *abcd*

(b) *abdc*

(c) *acbd*

(d) None of the above

42. Which of the following graphs $Gi = (Vi, Ei)$ is a tree?

(a) $V1 = \{A, B, C, D\}$ $E1 = \{AB, AC, AD\}$

(b) $V2 = \{A, B, C, D\}$ $E2 = \{AB, AD, BD\}$

(c) $V3 = \{A, B, C, D\}$ $E3 = \{AB, AC, BD, CD\}$

(d) $V4 = \{A, B, C, D\}$ $E4 = \{AB, AC, BD, CD, AD, BC\}$

43. For a set of functional dependencies $\{X \to Y, X \to Z\}$, which of the following is true?

(a) $\{X \to Y, X \to Z\} \Rightarrow XY \to Z$

(b) $\{X \to Y, X \to Z\} \Rightarrow X \to YZ$

(c) $\{X \to Y, X \to Z\} \Rightarrow X \to Y$ and $X \to Z$

(d) $\{X \to Y, X \to Z\} \Rightarrow XYZ$

44. Given the relation $R(a, b, c, d, e, f)$ with the functional dependencies

$$a, b \to c, d$$
$$e \to c$$
$$b \to e, f$$

What normal form is the relation R in?

(a) BCNF

(b) First normal form

(c) Normalized

(d) Second normal form

45. A collection of operations that performs a single logic function is called

(a) SQL query

(b) transaction

(c) DBA

(d) schema

46. The purpose of schema normalization is to

i. ensure security of data stored in the database

ii. reduce the number of joins required to satisfy a query

iii. reduce the number of anomalies that can occur during inserts, deletes and updates

iv. convert the data to normal form

Which of the following is correct?

(a) Only i and ii are correct statements

(b) All four are correct statements

(c) Only ii and iii are correct statements

(d) Only ii, iii and iv are correct statements

47. Dependency graph of a schedule must be

(a) bipartite

(b) complete

(c) acyclic

(d) binary tree

48. Which of the following is a heterogenous distributed database?

(a) The same DBMS is used at each location and data are not distributed across all nodes

(b) The same DBMS is used at each location and data are distributed across all nodes

(c) A different DBMS is used at each location and data are not distributed across all nodes

(d) A different DBMS is used at each location and data are distributed across all nodes

49. 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

50. The maximum window size for data transmission using the selective repeat ARQ protocol with n-bit frame sequence number is

    (a) 2^n

    (b) 2^{n-1}

    (c) $2^n - 1$

    (d) 2^{n-2}

51. 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

52. In an IPv4 packet, the value of HLEN is 5 and the value of the total length field is 0×0028. How many bytes of data are being carried by this packet?

(a) 10

(b) 20

(c) 28

(d) 40

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. Consider an instance of TCP's additive increase multiplicative decrease algorithm, where the window size at the start of the slow start phase is 2 MSS and the threshold at the start of the first transmission is 8 MSS. Assume that a timeout occurs during the fifth transmission. What is the size of the congestion window at the end of the tenth transmission?

(a) 8 MSS

(b) 7 MSS

(c) 12 MSS

(d) 14 MSS

55. Pipelining ensures

(a) increase in the throughput

(b) decrease in the execution time

(c) None of (a) and (b)

(d) Both (a) and (b)

56. MIPS ISA is designed based on four basic design principles. The design principle 3 says, 'Make the common case fast'. Which of the following instructions holds the command related to this design principle?

(a) addi $s3, $s3, 4

(b) jr $ra

(c) add $t1, $a2, $a3

(d) sub $s0, $t0, $t1

57. There are five addressing modes in MIPS. Which of the following is not one of them?

(a) Base addressing

(b) Pseudo-direct addressing

(c) Immediate addressing

(d) PC-direct addressing

58. Let us consider the following C statement :

$$f = -g + h + B[1];$$

To translate the statement from C to MIPS, we assume that the variables f, g, h, i and j are assigned to registers $s0, $s1, $s2, $s3 and $s4 respectively. If the base addresses of the arrays A and B are kept in the registers $s6 and $s7 respectively, the minimum number of MIPS assembly instructions needed to perform the C statement is

(a) 5

(b) 4

(c) 3

(d) 6

59. For a double-precision floating representation in MIPS, total number of bits available for the exponent is

(a)   8

(b)   11

(c)   23

(d)   1

60. Consider a swapping system in which memory consists of the following hole sizes in memory order : 10K, 4K, 20K, 15K and 9K. Which holes are taken for successive segment requests of 8K, 12K and 10K for the best fit?

(a)   10K 20K 15K

(b)   10K 20K 4K

(c)   9K 15K 10K

(d)   20K 15K 10K

61. Suppose there are 16 virtual pages and 4 page frames. Determine the number of page faults that will occur with the reference string 1 2 3 4 2 1 5 6 2 1 2 3 7 6 3 2 1 2 3 6 (assuming frames being empty initially) using optimal page replacement algorithms.

(a)   10

(b)   14

(c)   8

(d)   7

62. Suppose that a disk drive has 5000 cylinders, numbered 0 to 4999. The drive is currently serving a request at cylinder 143, and the previous request served was at cylinder 125. The queue of pending requests, in FIFO order is

86, 1470, 913, 1774, 948, 1509, 1022, 1750, 130

Starting from the current head position, what is the total distance (in cylinders) that the disk arm moves to satisfy all pending requests for SCAN disk scheduling algorithms?

(a)   7081

(b)   1745

(c)   9769

(d)   3319

63. To avoid the race condition, the number of processes that may be simultaneously inside their critical section is

(a) 8

(b) 1

(c) 16

(d) 0

64. The strategy of allowing processes that are logically runnable to be temporarily suspended, is called

(a) preemptive scheduling

(b) non-preemptive scheduling

(c) shortest job first

(d) first come first served

65. The LRU algorithm

(a) pages out pages that have been used recently

(b) pages out pages that have not been used recently

(c) pages out pages that have been least used recently

(d) pages out the first page in a given area

66. The prototyping model of software development is

(a) a reasonable approach when requirements are well defined

(b) a useful approach when a customer cannot define requirements clearly

(c) the best approach to use for projects with large development teams

(d) a risky model that rarely produces a meaningful product

67. The cyclomatic complexity metric provides the designer with information regarding the number of

(a) cycles in the program

(b) errors in the program

(c) independent logic paths in the program

(d) statements in the program

68. Which of the following is the advantage of using LOC (lines of code) as a size-oriented metric?

(a) LOC is easily computed

(b) LOC is a language dependent measure

(c) LOC is a language independent measure

(d) LOC can be computed before a design is completed

69. Which of the following provides useful measures of software quality?

(a) Correctness, business relevance, integrity, usability

(b) Reliability, maintainability, integrity, sales

(c) Correctness, maintainability, size, satisfaction

(d) Correctness, maintainability, integrity, usability

70. COCOMO II is an example of a suite of modern empirical estimation models that require sizing information expressed as

(a) function points

(b) lines of code

(c) object points

(d) Any of the above

★ ★ ★