Entrance Examination – 2019

Ph.D. in Computer Science

Time: 2 Hours   **Max. Marks: 70**

Hall Ticket Number:

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. 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.

4. Every correct answer gets **1 (one) mark**. There is negative marking of 0.33 marks for every **wrong answer**.

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.

Ph.D in Computer Science

Part A – Research Methodology

1. Consider the polynomial $p(x) = c_0 + c_1 x + c_2 x^2 + c_3 x^3$, where no coefficient is 0. The minimum number of multiplications required to evaluate p on an input x is

   A. 6
   B. 4
   C. 3
   D. 8

2. If $S = \{x | 0 < x < 12\}$, $M = \{x | 1 < x < 9\}$ and $N = \{x | 0 < x < 5\}$, find $M' \cap N'$.

   A. $\{x | 9 \leq x < 5\}$
   B. $\{x | 9 < x < 12\}$
   C. $\{x | 0 < x < 12\}$
   D. $\{x | 5 < x < 9\}$

3. Let E, F and G be finite sets and let $A = (E \cap F) - (F \cap G)$ and $B = (E - (E \cap G)) - (E - F)$. Which one of the following is true?

   A. $A \subset B$
   B. $B \subset A$
   C. $A = B$
   D. None of the Above.

4. If the word FORGET is encoded as DPPHCU, then THINK is encoded as

   A. VGKMM
   B. RIILI
   C. RIGOI
   D. RIGOR

5. Seven (distinct) road accidents occurred in a week. What is the probability that they all occurred on the same day?

   A. 7^{-6}
   B. 7^{-2}
   C. 2^{-7}
   D. 7^{-7}

6. What is the maximum number of different Boolean functions involving n Boolean variables?

   A. n^{2^n}
   B. 2^n
   C. 2^{2^n}
   D. n^2

Given below is a chart of rainfall amounts in *Quinquinox* city on a distant planet *Quinox* revolving around an equally distant Star. It has its own months and years. Year is, of course, the time taken in their own units of measurement to revolve once around their Star.

Examine the chart carefully and answer Questions 7 – 9.
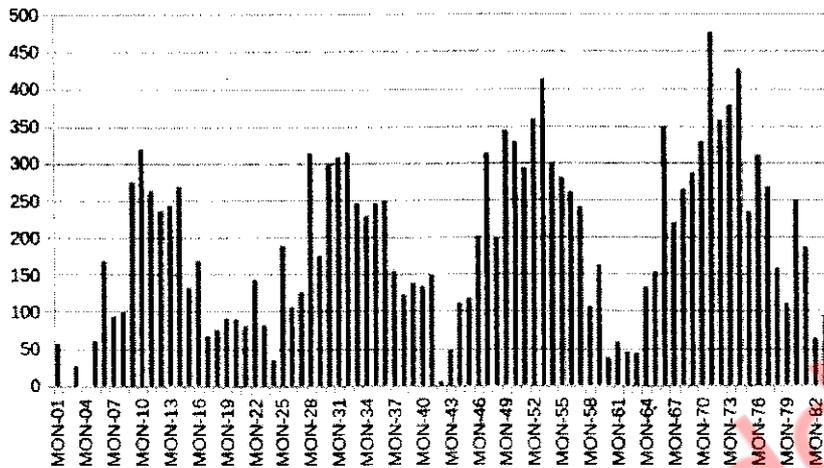
7. How many months are there in a year on *Quinox*?

   A. 10

   B. 20

   C. 28

   D. Not possible from the data given

8. If climate is classified into the following three categories,

   QNd Seasonal rainfall with wet season being short

   QNe Uniform rainfall throughout the year

   QNm Seasonal rainfall with wet season being long

   Which category describes the climate of *Quinquinox*?

   A. QNm

   B. QNe

   C. QNd

   D. Not possible from the data given

9. If the year on *Quinox* starts with Mon-01 (which is also the first data point), which month in a year is the wettest?

   A. 18

   B. 12

   C. 8

   D. 5

2

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10. Let S be a set of n elements. The number of ordered pairs in the largest and the smallest equivalence relations on S are

A. n^2 and n

B. n^2 and 0

C. $\dfrac{n(n+1)}{2}$ and n

D. $\dfrac{n(n+1)}{2}$ and 0

11. Here is a puzzle: find a number x such that x leaves a remainder of 9 when divided by 10, a remainder of 8 when divided by 9, a remainder of 7 when divided by 8, ..., a remainder of 2 when divided by 3 and a remainder of 1 when divided by 2.

How many such numbers are there?

A. 0

B. Exactly 1

C. 2

D. Infinite

12. Car A goes 200 Kms at an average speed of 40 Kmph in one direction and returns to the starting point covering the distance of 200 Kms at an average speed of 50 Kmph. Another Car B goes 200 Kms at an average speed of 45 Kmph and does the return journey of 200 Kms also at an average speed of 45 Kmph. Which statement is TRUE about the two cars A and B?

A. Car A takes less time than Car B

B. Car B takes less time than Car A

C. Both Cars A and B take the same time

D. Cannot be determined from the data given

13.
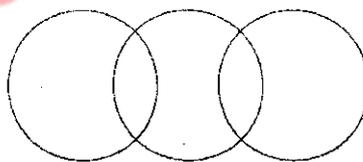

Which of the following is correctly represented by the Venn diagram above?

A. Elephants, Wolves, Animals

B. Dogs, Cats, Pets

C. Pigeons, Dogs, Birds

D. Tables, Chairs, Furniture

Questions 14 – 16 are based on the Venn diagram below.

S represents all integers between 1 and 30, P represents prime numbers between 1 and 30, M represents multiples of 3 between 1 and 30, and F represents all factors of 30.
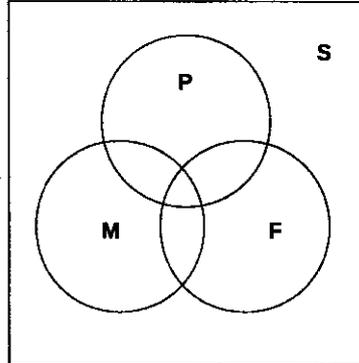
14. If $G = P \cap M \cap F$, then

    A. $G = \{3\}$
    B. $G = \{3, 5\}$
    C. $G = \{1\}$
    D. $G = \{1, 3, 5\}$

15. What are the numbers in F but not in P or M?

    A. 1, 10
    B. Only 1
    C. Only 10
    D. 1, 3, 10

16. What is the cardinality of $P \cap F$?

    A. 1
    B. 2
    C. 3
    D. 4

Read the paragraphs below and answer Questions 17 – 19.

When looking back on any kind of movement or revolution, one always likes to point to a beginning: "It began right there — it all started with so-and-so's famous speech..." If structured programming can be thought of as a revolution, then surely Dijkstra's land-mark paper, "Programming Considered as a Human Activity," published in 1965, marks its beginning. Virtually the entire gospel of structured programming is contained in a few short pages: the arguments against goto statements, the notion of top-down design, the emphasis on program correctness and quality (or "elegance," as Dijkstra prefers to call it), and the strong argument against programs that modify themselves.

In addition to these fundamental concepts, there are some rather classic phrases that first appeared in this paper, and that have popped-up in dozens of subsequent articles and books. For example, when discussing the "divide and conquer" approach characterizing top-down design, Dijkstra admits, "I have only a very small head, and must live with it." What seems obvious to

us today was a rather novel idea in 1965: the idea that while computers were —— and still are —— getting faster and more powerful, human beings weren't.

This theme is repeated again and again, and is essentially the entire subject matter of Dijkstra's 1972 speech, "The Humble Programmer." ...Once you do read it, you can see why Dijkstra has the reputation he does. His writing is succinct and yet convincing. Reading Dijkstra, someone said, has been compared to eating marzipan — it's best to take very small bites, chew slowly, and digest the mouthful before moving on to the next bite.

17. What is said to have begun with Dijkstra's landmark paper, "Programming Considered as a Human Activity" in 1965?

    A. Structured programming

    B. Programs which modify themselves that eventually led to viruses

    C. High salaries to programmers

    D. Computer revolution

18. Which of the following is NOT a part of structured programming?

    A. Elimination of goto statements

    B. Top-down design

    C. Self-modifying code

    D. Emphasis on *elegance*

19. Reading Dijkstra should be like eating marzipan – what does this mean?

    A. His prose is very difficult to read like marzipan which should be eaten slowly to appreciate its taste

    B. His prose is so good that it should be read slowly to enjoy and understand it just like marzipan which should be eaten slowly to really enjoy its taste

    C. His prose is difficult and we cannot read it quickly just like eating marzipan whose taste is so nasty that we can only eat small pieces

    D. His prose is so good that it should be read all at once like swallowing something tasty

20. Two cards are drawn together from a pack of 52 cards (a set of traditional playing cards) at random. What is the probability that one is a spade and one is a heart?

    A. 13/102

    B. 3/20

    C. 47/100

    D. 29/342

21. The ratio of the number of boys and girls in a class is 4:3. If 10% of the boys and 20% of the girls are scholarship holders, what is the percentage of students who do not get scholarship?

    A. 76

    B. $75\frac{5}{7}$

    C. $85\frac{5}{7}$

    D. 86

22. How many squares are there in the following figure?
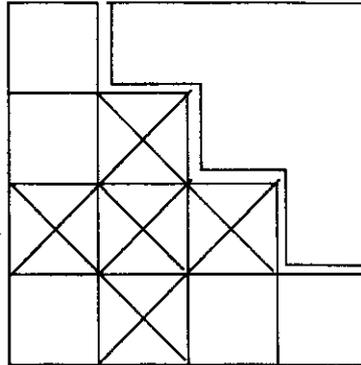
A. 14
B. 15
C. 17
D. 18

23. Two candidates were contesting for the post of the chairperson of a committee, 3/4th of the members voted for A and 3/5th for B, 30 members voted in favour of both the candidates and 9 members did not cast their vote. Find the total number of members who cast their votes.

A. 60
B. 80
C. 57
D. 51

Answer Questions 24 – 26 based on the following information.

A, B, C, D, E and F are 6 relatives. Their relationships are:

(a) B is the son of C, but C is not the mother of B
(b) D is the daughter of A
(c) F is the brother of B
(d) A and C are a married couple
(e) E is the brother of C

24. Who is the mother of B?

A. F
B. E
C. D
D. A

25. How many children does A have?

A. 1
B. 2
C. 3
D. 4

26. Which of the following statements is/are TRUE?

    A. E is D's uncle

    B. E is D's daughter

    C. F is E's son

    D. D and F are sisters

27. Words are sorted according to the following two rules applied in order: (a) nouns come before verbs, verbs come before adjectives, adjectives come before adverb; (b) a letter with less number of straight line segments comes before one with more straight lines, e.g., V (2 stright lines) comes before E (4 straight lines).

    Given the words, ACADEMY, NEST, SUPERB, SUNDAY, NOTING, the correct ascending order is

    A. NEST, SUNDAY, SUPERB, ACADEMY, NOTING

    B. SUNDAY, ACADEMY, NEST, NOTING, SUPERB

    C. SUNDAY, SUPERB, ACADEMY, NEST, NOTING

    D. ACADEMY, NEST, NOTING, SUNDAY, SUPERB

28. A shelf has between 75 and 100 books. 1/6th of them are novels and 12.5% of them are biographies. Find the number of books.

    A. 76

    B. 88

    C. 96

    D. None of the Above

29. A box contains 4 black 3 red and 5 green balls, 2 balls are drawn from the box at random. What is the probability that both the balls are of the same color?

    A. 1/6

    B. 19/66

    C. 47/66

    D. 2/11

30. What is the first letter of a meaningful English word formed from the 1st, 4th, 7th and 11th letters of "SUPERFLUOUS"?

    A. E

    B. L

    C. R

    D. S

31. The following figure shows a ring containing 105 teeth inside which is a wheel with 80 teeth. The black dots – one on the wheel and one on the ring are initially aligned as shown. The wheel

is now rotated anti-clockwise along the ring with no slippage. After how many revolutions of the wheel will it return to the initial alignment?
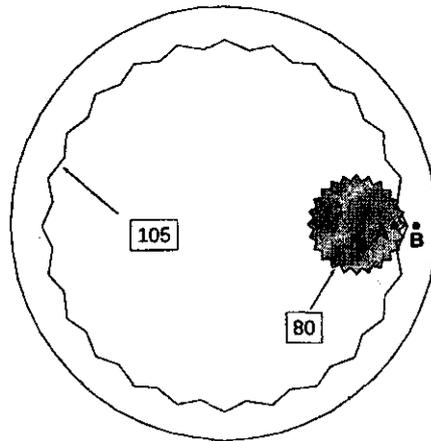
- A. 5
- B. 15
- C. 21
- D. 26

32. What is the cardinality of the power set of $\{a, b, \{a, b\}\}$?

- A. 8
- B. 16
- C. 9
- D. 15

33. In Research Methodology, what does the word *Ontology* refer to?

- A. Concepts and categories, their properties and relationships
- B. Research papers and journals, their citation indices and impact factors
- C. Cancers, diseases their treatments and hospitals
- D. A word indexing method

34. Which of the following is given as a classic example of *proof by contradiction*?

- A. If a, b, c are positive integers, then $a^n + b^n \neq c^n$ for any $n > 2$
- B. The number of primes is infinite
- C. The sum of first n integers is $\dfrac{n(n+1)}{2}$
- D. If a, b, c are the sides of a right-angled triangle and c is its hypotenuse, then $a^2 + b^2 = c^2$

35. Some possible reasons for *Literature Review* in research are given below. Read them and answer the question given below.

- I. Show the state-of-the-art so that the significance of the solution proposed is clear to the reader.
- II. Give a correct context to the scope of the work proposed in the thesis.
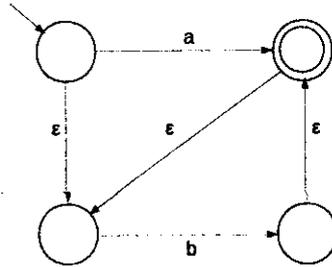- III. Demonstrate the scholarliness of the thesis writer.

IV. Fill the minimum page requirement for a thesis.

Which of the above statements are VALID reasons?

A. I and II

B. I and III

C. II and III

D. None of the Above

Part – B: Computer Science

36. What is the language of the Non-deterministic Finite Automaton(NFA) on $\Sigma = \{a, b\}$ given below?

   A. a^*b^*

   B. $a \cdot b^*$

   C. $a + b^*$

   D. $(ab)^*$

37. The language of the following CFG on $\Sigma = \{a, b\}$ given by

$$S \rightarrow aSb \mid SS \mid \epsilon$$

   with $n_a(w)$ denoting the number of a's present in w is

   A. $\{a^n b^n : n \geq 0\}$

   B. $\{w : n_a(w) = n_b(w) \text{ and } n_a(v) \geq n_b(v) \text{ where } v \text{ is any prefix of } w\}$

   C. $\{w : n_a(w) \neq n_b(w)\}$

   D. $\{w : n_a(w) = n_b(w)\}$

38. Consider the ultimate software verification problem: A software that can verify any program submitted as input to check if it is correct or not. This problem is

   A. Undecidable

   B. Decidable

   C. Context Free

   D. NP-Hard

39. Which of the following statements is FALSE?

   A. For every Non-deterministic PDA there exists an equivalent DPDA

   B. For every Non-deterministic TM there exists an equivalent deterministic TM

   C. For every regular expression there exists an equivalent NFA

   D. For every NFA there exists an equivalent DFA

40. A random-access read/write semiconductor memory chip is organized into 128 words of 8 bits each. A larger memory of 4K words of 16 bits each (K = 1024) may be obtained by connecting

   A. 32 chips in a 16 x 2 array

   B. 32 chips in a 32 x 1 array

   C. 64 chips in a 32 × 2 array

   D. 64 chips in a 8x8 array

41. A certain computer represents floating point numbers by means of a signed magnitude fractional mantissa and an excess-16 base 4 exponent. The floating point format number is 110010111000. What is its decimal value?

A. -3.5

B. -14

C. -7/8

D. -2

42. Which of the following is true of interrupts?

A. They are generated when memory cycles are "stolen".

B. They are used in place of data channels.

C. They can indicate completion of an I/O operation.

D. They cannot be generated by arithmetic operations.

43. The following assembly language program fragment was written for a single-address computer with one accumulator register. What is stored in z?

```
LOAD b
MULT c
STORE t1
ADD a
STORE t2
MULT t2
ADD t1
STORE z
```

A. $(a + bc)^2 + bc$

B. $-t1(bc - a) - t2$

C. $2bc + a^2$

D. $(a + bc) + bc$

44. The logic circuit given below is used to compare two unsigned 2-bit numbers, $X_1 X_0 = X$ and $Y_1 Y_0 = Y$, where X_0 and Y_0 are the least significant bits. (A small circle on any line in a logic diagram indicates logical NOT). Which of the following always makes the output Z have the value 1?
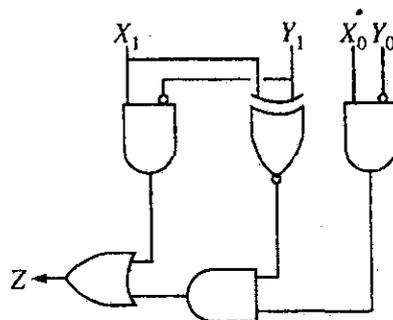

A. $X > Y$

B. $X < Y$

C. $X = Y$

D. $X \geq Y$

45. The constraint that specifies the number of entities to which another entity can be associated via a relationship set in E-R model is referred as

   A. Mapping cardinality

   B. Entity integrity

   C. Domain integrity

   D. Assertion

46. An attribute "Address" is divided into Street, City, state, Zip and Country. The attribute "Address" is referred as

   A. Single valued attribute

   B. Multivalued attribute

   C. Composite attribute

   D. Derived attribute

47. The relationship associating the weak entity set with the identifying set is called

   A. Partial entity set

   B. Identifying relationship

   C. Aggregation

   D. IS-A relationship

48. If E1 and E2 are relational algebra expressions then which of the following is NOT a relational algebra expression

   A. $E1 \cup E2$

   B. $E1 \times E2$

   C. $E1 - E2$

   D. $E1 / E2$

49. The set of statements that are executed automatically as a side effect of a modification to the database is a

   A. Function

   B. Procedure

   C. Package

   D. Trigger

50. A digital signaling system is required to operate at 9600 bps. If a signal element encodes a 4-bit word, what is the minimum required bandwidth of the channel?

   A. 1200Hz

   B. 4800Hz

   C. 19200Hz

   D. 1900Hz

51. Host 130.37.56.201 is on a Class ____ Network.

   A. A
   B. B
   C. C
   D. D

52. A TCP segment consisting of 1500 bits of data and 160 bits of header is sent to the IP layer, which appends another 160 bits of header. This is then transmitted through two networks, each of which uses a 24-bit packet header. The destination network has a maximum packet size of 800 bits. How many bits, including headers, are delivered to the network layer protocol at the destination?

   A. 1820
   B. 1844
   C. 1868
   D. 1892

53. A slotted LAN has m stations. The probability for individual station to transmit is t in a time slot. What shall be the probability that in a given time slot ONLY one station transmits?

   A. $mt(1-t)^{m-1}$
   B. $(1-t)^{m-1}$
   C. $t(1-t)^{m-1}$
   D. $1-(1-t)^{m-1}$

54. Two systems S1 and S2 are configured with the following IP address:

   S1: 203.197.2.53; netmask 255.255.128.0
   S2: 203.197.75.201;netmask 255.255.192.0

   Which one of the following statements is true?

   A. S1 assumes S2 is on same network, but S2 assumes S1 is on a different network
   B. S2 assumes S1 is on same network, but S1 assumes S2 is on a different network
   C. S1 and S2 both assume they are on the same network
   D. S1 and S2 both assume they are on different networks

55. Computer P sends 64 byte messages to Computer Q through a sliding window protocol. The delay between P and Q is 160 ms and the bandwidth is 256 kbps. What is the optimal size of the window for P to send messages?

   A. 40
   B. 80
   C. 320
   D. 640

56. In the following process state transition diagram for a uniprocessor system, assume that there are always some processes in the ready state. Now, consider the following statements.
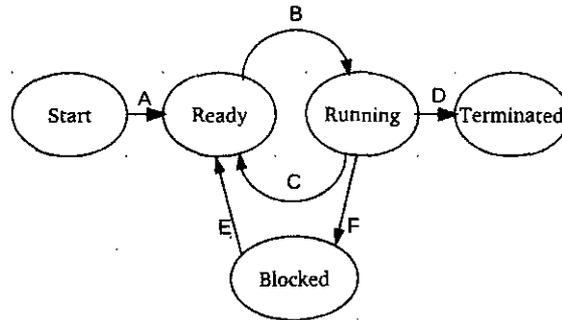
   I.   If a process makes a transition D, it would result in another process making transition A immediately

   II. A process P2 in blocked state can make transition E while another process P1 is in running state

   III. The OS uses preemptive scheduling

   IV. The OS uses non-preemptive scheduling

   Which of the above statements are TRUE?

   A. I and II
   B. I and III
   C. II and III
   D. II and IV

57. Consider a disk pack with 16 surfaces, 128 tracks per surface and 256 sectors per track. 512 bytes of data are stored in a bit serial manner in a sector. The capacity of the disk pack and the number of bits required to specify a particular sector in the disk are respectively:

   A. 256 MB, 19b
   B. 256 MB, 8b
   C. 512 MB, 20b
   D. 64 GB, 28b

58. Identify the correct order in which a server process must invoke the function calls accept, bind, listen and recv according to UNIX socket API.

   A. listen, accept, bind, recv
   B. bind, listen, accept, recv
   C. bind, accept, listen, recv
   D. accept, listen, bind, recv

59. Let f be a Boolean expression in 8 variables which has *true* value exactly for 4 combinations out of 2^8 possible combinations. Then f can be expressed as sum of _____ minterms.

   A. 10
   B. 8
   C. 6
   D. 4

Ph.D in Computer Science

60. One of the main limitations of Hierarchical databases is

    A. Limited capacity
    B. Overheads associated with maintaining indices
    C. Limited flexibility in data access
    D. Poor performance

61. Consider a Relational schema $R(A, B, C, D)$ and functional dependencies $A \rightarrow B$ and $C \rightarrow D$. Then the decomposition of R into $R_1(A, B)$ and $R_2(C, D)$ is

    A. dependency preserving and lossless join
    B. lossless join but not dependency preserving
    C. dependency preserving but not lossless join
    D. neither dependency-preserving nor lossless join

62. What is the highest normal form of a relation $R(A, B, C, D, E)$ with FD set?

$$\{B \rightarrow A, A \rightarrow C, BC \rightarrow D, AC \rightarrow BE\}$$

    A. 2NF
    B. 3NF
    C. BCNF
    D. 4NF

63. Which of the following statements is TRUE about static variables in C?

    A. Their lifetime is exactly the same as the lifetime of the program
    B. Their lifetime is exactly the same as a register variable
    C. Their lifetime is exactly the same as that of the function in which they are declared, but they retain their value between calls
    D. None of the Above

64. An array of integers is declared in C language as

                int pat[32][10];

    Which of the following array elements are in adjacent locations in memory?

    A. pat[31][6], pat[0][7]
    B. pat[28][0], pat[28][9]
    C. pat[15][0], pat[16][0]
    D. None of the Above.

65. A shop announces a grand 13th anniversary sale where every customer is allowed to take 1300 worth of goods from the items listed below (each weighs 5 Kg). A person wishes to take items totalling 15 Kg in weight because airlines allow only 15 Kg to be carried. Which type of algorithm gives the correct solution to the problem of picking up items satisfying both the weight and free gift amount constraints?

                Item A: 100, Item B: 300, Item C: 600, Item D: 800, Item E: 750

    A. Greedy based on cost/weight ratio
    B. Divide-and-Conquer

C. Dynamic Programming

D. None of the Above

66. Consider the following statements:

I. SRAMs are made up of flip-flops each storing 1 bit

II. SRAMs are slower than DRAMs because SRAMs need more transistors than DRAMs which use a transistor and a capacitor

III. SRAMs are more expensive than DRAMs

Which of the above statements are TRUE?

A. I and II only

B. I and III only

C. II and III only

D. All

67. Processes P1 and P2 use `critical_flag` in the following routine to achieve mutual exclusion. Assume that `critical_flag` is initialized to FALSE in the main program.

```
get_exclusive_access ( )
{
    if (critical _flag == FALSE) {
      . critical_flag = TRUE ;
        critical_region () ;
        critical_flag = FALSE;
    }
}
```

Consider the following statements.

I. It is possible for both P1 and P2 to enter critical region concurrently.

II. It is possible for deadlock to occur.

Which of the following holds TRUE?

A. I is FALSE but II is TRUE

B. I is TRUE but II is FALSE

C. Both I and II are FALSE

D. Both I and II are TRUE

68. A Page Table is given below in a virtual memory system having a page size of 1024. Each virual address is in the form $[p, d]$ where p and d are the page number and the displacement in that page, respectively. A virtual address of $[0, 514]$ maps to an actual address of

A. 514

B. 1024

C. 2562

D. 3586

69. Nodes in a *Resource Allocation Graph* are

    A. Processes
    B. Resources
    C. Processes and Resources
    D. Outstanding resource requests

70. Which of the following page replacement algorithms DOES NOT suffer from Bèlàdy's Anomaly?

    A. First Come First Serve
    B. LRU
    C. Most Recently Used
    D. None of the Above

THE   END

University of Hyderabad

Entrance Examinations - 2019

School/Department/Centre : Computer and Information Sciences

Course/Subject : Ph.D. in Computer Science

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

Note/Remarks :

Signature P. N. Girija

School/Department/Centre 6/6/19