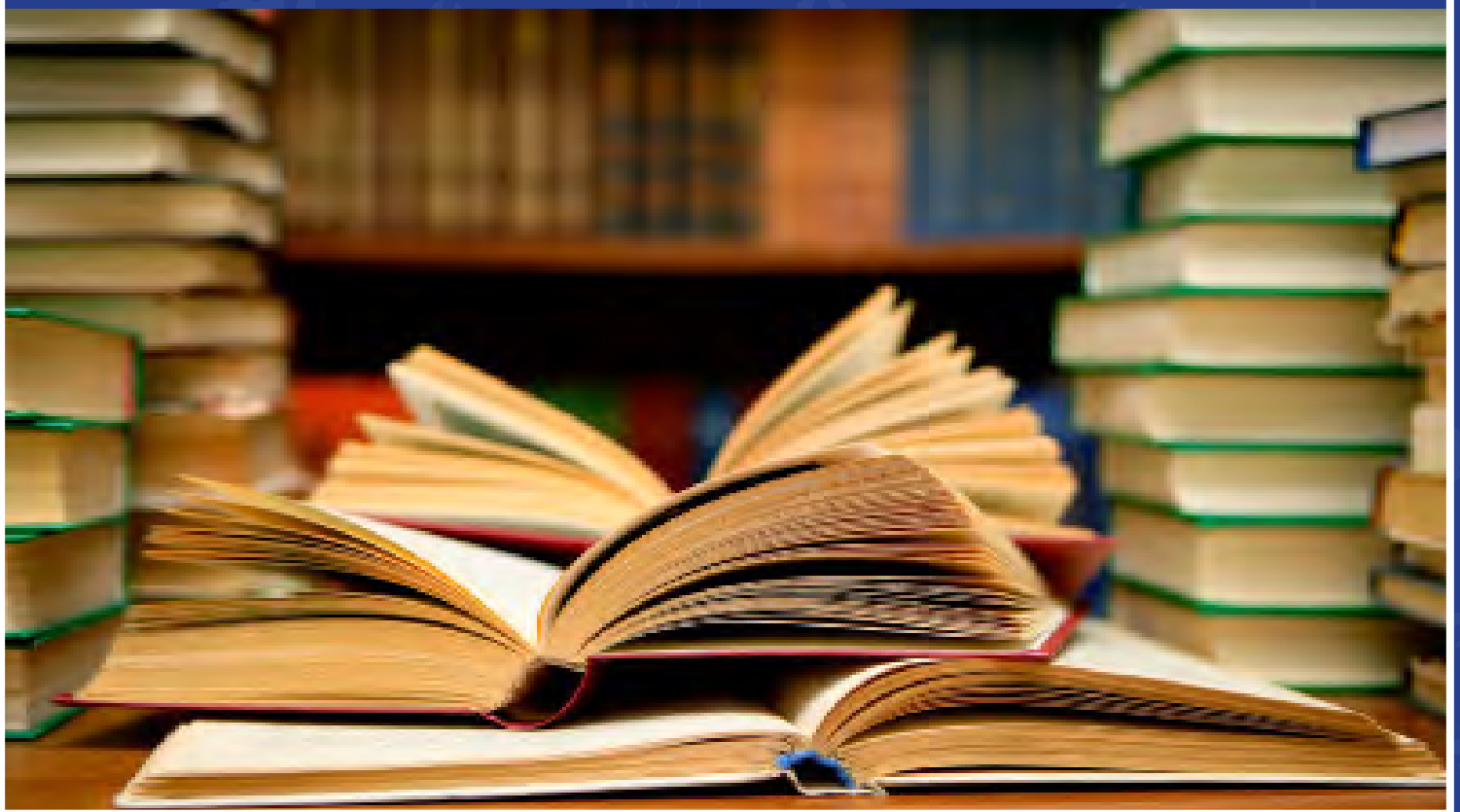


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GATE

Computer Science & Information Technology Engineering Question Papers E-Book (2013-2015) SOLVED



Introduction

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GATE
Computer Science and
Information Technology
Engineering
Question Paper
2015
(with Solutions)

Graduate Aptitude Test in Engineering

Notations :

- Options shown in green color and with ✓ icon are correct.
- Options shown in red color and with ✗ icon are incorrect.

Question Paper Name: CS: COMPUTER SCIENCE AND INFORMATION TECHNOLOGY 8th Feb Shift I
Number of Questions: 65
Total Marks: 100.0

Wrong answer for MCQ will result in negative marks, (-1/3) for 1 mark Questions and (-2/3) for 2 marks Questions.

General Aptitude

Number of Questions: 10
Section Marks: 15.0

Q.1 to Q.5 carry 1 mark each & Q.6 to Q.10 carry 2 marks each.

Question Number : 1 Question Type : MCQ

Extreme focus on syllabus and studying for tests has become such a dominant concern of Indian students that they close their minds to anything _____ to the requirements of the exam.

- (A) related (B) extraneous (C) outside (D) useful

Options :

- ✗ A
- ✓ B
- ✗ C
- ✗ D

Question Number : 2 Question Type : MCQ

Select the pair that best expresses a relationship similar to that expressed in the pair:

Children : Pediatrician

- (A) Adult : Orthopaedist (B) Females : Gynaecologist
(C) Kidney : Nephrologist (D) Skin : Dermatologist

Options :

- ✗ A
- ✓ B
- ✗ C
- ✗ D

Question Number : 3 Question Type : MCQ

The Tamil version of _____ John Abraham-starrer *Madras Cafe* _____ cleared by the Censor Board with no cuts last week, but the film's distributors _____ no takers among the exhibitors for a release in Tamil Nadu _____ this Friday.

- (A) Mr., was, found, on (B) a, was, found, at
(C) the, was, found, on (D) a, being, find at

Options :

1. ✖ A
2. ✖ B
3. ✔ C
4. ✖ D

Question Number : 4 Question Type : MCQ

If ROAD is written as URDG, then SWAN should be written as:

- (A) VXDQ
(B) VZDQ
(C) VZDP
(D) UXDQ

Options :

1. ✖ A
2. ✔ B
3. ✖ C
4. ✖ D

Question Number : 5 Question Type : MCQ

A function $f(x)$ is linear and has a value of 29 at $x = -2$ and 39 at $x = 3$. Find its value at $x = 5$.

- (A) 59 (B) 45 (C) 43 (D) 35

Options :

1. ✖ A
2. ✖ B
3. ✔ C
4. ✖ D

Question Number : 6 Question Type : MCQ

Alexander turned his attention towards India, since he had conquered Persia.

Which one of the statements below is logically valid and can be inferred from the above sentence?

- (A) Alexander would not have turned his attention towards India had he not conquered Persia.
(B) Alexander was not ready to rest on his laurels, and wanted to march to India.
(C) Alexander was completely in control of his army and could command it to move towards India.
(D) Since Alexander's kingdom extended to Indian borders after the conquest of Persia, he was keen to move further.

Options :

1. ✓ A
2. ✗ B
3. ✗ C
4. ✗ D

Question Number : 7 Question Type : MCQ

Most experts feel that in spite of possessing all the technical skills required to be a batsman of the highest order, he is unlikely to be so due to lack of requisite temperament. He was guilty of throwing away his wicket several times after working hard to lay a strong foundation. His critics pointed out that until he addressed this problem, success at the highest level will continue to elude him.

Which of the statement(s) below is/are logically valid and can be inferred from the above passage?

- (i) He was already a successful batsman at the highest level.
- (ii) He has to improve his temperament in order to become a great batsman.
- (iii) He failed to make many of his good starts count.
- (iv) Improving his technical skills will guarantee success.

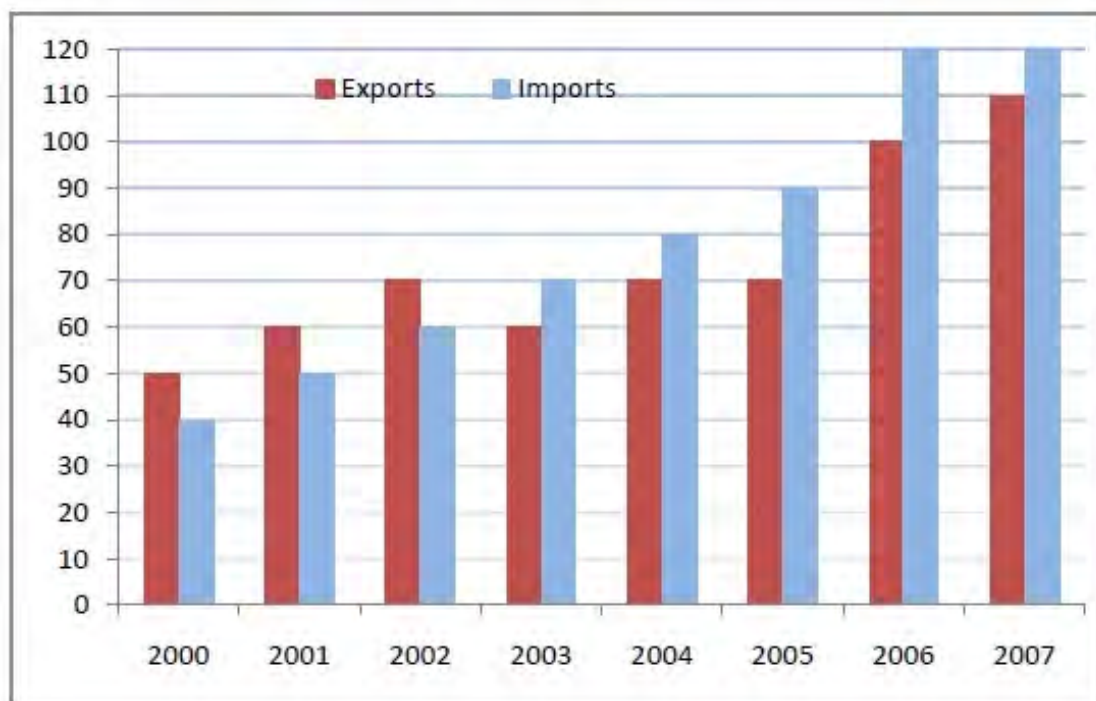
- (A) (iii) and (iv)
- (B) (ii) and (iii)
- (C) (i), (ii) and (iii)
- (D) (ii) only

Options :

1. ✗ A
2. ✓ B
3. ✗ C
4. ✗ D

Question Number : 8 Question Type : NAT

The exports and imports (in crores of Rs.) of a country from the year 2000 to 2007 are given in the following bar chart. In which year is the combined percentage increase in imports and exports the highest?

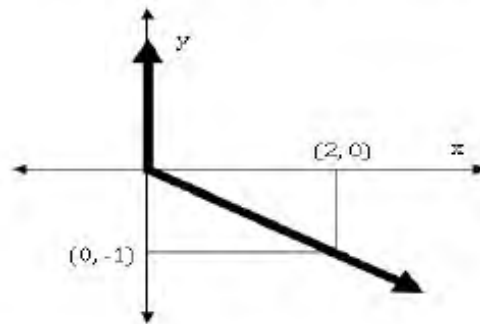


Correct Answer:

2006

Question Number : 9 Question Type : MCQ

Choose the most appropriate equation for the function drawn as a thick line, in the plot below.



- (A) $x = y - |y|$ (B) $x = -(y - |y|)$ (C) $x = y + |y|$ (D) $x = -(y + |y|)$

Options :

1. ✗ A
2. ✓ B
3. ✗ C
4. ✗ D

Question Number : 10 Question Type : MCQ

The head of a newly formed government desires to appoint five of the six selected members P, Q, R, S, T, and U to portfolios of Home, Power, Defense, Telecom, and Finance. U does not want any portfolio if S gets one of the five. R wants either Home or Finance or no portfolio. Q says that if S gets either Power or Telecom, then she must get the other one. T insists on a portfolio if P gets one.

Which is the valid distribution of portfolios?

- (A) P-Home, Q-Power, R-Defense, S-Telecom, T-Finance
(B) R-Home, S-Power, P-Defense, Q-Telecom, T-Finance
(C) P-Home, Q-Power, T-Defense, S-Telecom, U-Finance
(D) Q-Home, U-Power, T-Defense, R-Telecom, P-Finance

Options :

1. ✗ A
2. ✓ B
3. ✗ C
4. ✗ D

Computer Science and Information Technology

Number of Questions: 55
Section Marks: 85.0

Q.11 to Q.35 carry 1 mark each & Q.36 to Q.65 carry 2 marks each.

Question Number : 11 Question Type : MCQ

Consider the following C program segment.

```
#include <stdio.h>

int main()
{
    char s1[7] = "1234", *p;
    p = s1 + 2;
    *p = '\0';
    printf("%s", s1);
}
```

What will be printed by the program?

- (A) 12 (B) 120400 (C) 1204 (D) 1034

Options :

1. ✖ A
2. ✖ B
3. ✔ C
4. ✖ D

Question Number : 12 Question Type : MCQ

Suppose U is the power set of the set $S = \{1,2,3,4,5,6\}$. For any $T \in U$, let $|T|$ denote the number of elements in T and T' denote the complement of T . For any $T, R \in U$, let $T \setminus R$ be the set of all elements in T which are not in R . Which one of the following is true?

- (A) $\forall X \in U (|X| = |X'|)$
(B) $\exists X \in U \exists Y \in U (|X| = 5, |Y| = 5 \text{ and } X \cap Y = \emptyset)$
(C) $\forall X \in U \forall Y \in U (|X| = 2, |Y| = 3 \text{ and } X \setminus Y = \emptyset)$
(D) $\forall X \in U \forall Y \in U (X \setminus Y = Y' \setminus X')$

Options :

1. ✖ A
2. ✖ B
3. ✖ C
4. ✔ D

Question Number : 13 Question Type : MCQ

Consider the relation $X(P, Q, R, S, T, U)$ with the following set of functional dependencies

$$F = \left\{ \begin{array}{l} \{P, R\} \rightarrow \{S, T\}, \\ \{P, S, U\} \rightarrow \{Q, R\} \end{array} \right\}$$

Which of the following is the trivial functional dependency in F^+ , where F^+ is closure of F ?

- (A) $\{P, R\} \rightarrow \{S, T\}$ (B) $\{P, R\} \rightarrow \{R, T\}$ (C) $\{P, S\} \rightarrow \{S\}$ (D) $\{P, S, U\} \rightarrow \{Q\}$

Options :

1. ✖ A

2. ✖ B
3. ✔ C
4. ✖ D

Question Number : 14 Question Type : MCQ

The maximum number of processes that can be in *Ready* state for a computer system with n CPUs is

- (A) n (B) n^2 (C) 2^n (D) Independent of n

Options :

1. ✖ A
2. ✖ B
3. ✖ C
4. ✔ D

Question Number : 15 Question Type : MCQ

Among simple LR (SLR), canonical LR, and look-ahead LR (LALR), which of the following pairs identify the method that is very easy to implement and the method that is the most powerful, in that order?

- (A) SLR, LALR
(B) Canonical LR, LALR
(C) SLR, canonical LR
(D) LALR, canonical LR

Options :

1. ✖ A
2. ✖ B
3. ✔ C
4. ✖ D

Question Number : 16 Question Type : MCQ

Let $\#$ be a binary operator defined as

$$X \# Y = X' + Y' \text{ where } X \text{ and } Y \text{ are Boolean variables.}$$

Consider the following two statements.

- (S1) $(P \# Q) \# R = P \# (Q \# R)$
(S2) $Q \# R = R \# Q$

Which of the following is/are true for the Boolean variables P , Q and R ?

- (A) Only S1 is true
(B) Only S2 is true
(C) Both S1 and S2 are true
(D) Neither S1 nor S2 are true

Options :

1. ✖ A

- 2. ✓ B
- 3. ✗ C
- 4. ✗ D

Question Number : 17 Question Type : NAT

Consider a software project with the following information domain characteristics for calculation of function point metric.

Number of external inputs (I) = 30
Number of external outputs (O) = 60
Number of external inquiries (E) = 23
Number of files (F) = 08
Number of external interfaces (N) = 02

It is given that the complexity weighting factors for I, O, E, F and N are 4, 5, 4, 10 and 7, respectively. It is also given that, out of fourteen value adjustment factors that influence the development effort, four factors are not applicable, each of the other four factors have value 3, and each of the remaining factors have value 4. The computed value of function point metric is _____

Correct Answer:

612 to 613

Question Number : 18 Question Type : MCQ

In a web server, ten WebPages are stored with the URLs of the form `http://www.yourname.com/var.html`; where, *var* is a different number from 1 to 10 for each Webpage. Suppose, the client stores the Webpage with *var* = 1 (say W1) in local machine, edits and then tests. Rest of the WebPages remains on the web server. W1 contains several relative URLs of the form "*var.html*" referring to the other WebPages. Which one of the following statements needs to be added in W1, so that all the relative URLs in W1 refer to the appropriate WebPages on the web server?

- (A) `<a href: "http://www.yourname.com/", href: "...var.html">`
- (B) `<base href: "http://www.yourname.com/">`
- (C) `<a href: "http://www.yourname.com/">`
- (D) `<base href: "http://www.yourname.com/", range: "...var.html">`

Options :

- 1. ✗ A
- 2. ✓ B
- 3. ✗ C
- 4. ✗ D

Question Number : 19 Question Type : MCQ

Consider the following statements.

- I. TCP connections are full duplex
- II. TCP has no option for selective acknowledgement
- III. TCP connections are message streams

- (A) Only I is correct
- (B) Only I and III are correct
- (C) Only II and III are correct
- (D) All of I, II and III are correct

Options :

- 1. ✓ A
- 2. ✗ B
- 3. ✗ C
- 4. ✗ D

Question Number : 20 Question Type : MCQ

Consider the equality $\sum_{i=0}^n i^3 = X$ and the following choices for X

- I. $\Theta(n^4)$
- II. $\Theta(n^5)$
- III. $O(n^5)$
- IV. $\Omega(n^3)$

The equality above remains correct if X is replaced by

- (A) Only I
- (B) Only II
- (C) I or III or IV but not II
- (D) II or III or IV but not I

Options :

- 1. ✗ A
- 2. ✗ B
- 3. ✓ C
- 4. ✗ D

Question Number : 21 Question Type : NAT

Consider a binary tree T that has 200 leaf nodes. Then, the number of nodes in T that have exactly two children are _____.

Correct Answer :

199

Question Number : 22 Question Type : NAT

Given a hash table T with 25 slots that stores 2000 elements, the load factor α for T is _____.

Correct Answer :

80

Question Number : 23 Question Type : MCQ

In the given matrix $\begin{bmatrix} 1 & -1 & 2 \\ 0 & 1 & 0 \\ 1 & 2 & 1 \end{bmatrix}$, one of the eigenvalues is 1. The eigenvectors corresponding to the eigenvalue 1 are

(A) $\{\alpha(4, 2, 1) | \alpha \neq 0, \alpha \in \mathbb{R}\}$

(B) $\{\alpha(-4, 2, 1) | \alpha \neq 0, \alpha \in \mathbb{R}\}$

(C) $\{\alpha(\sqrt{2}, 0, 1) | \alpha \neq 0, \alpha \in \mathbb{R}\}$

(D) $\{\alpha(-\sqrt{2}, 0, 1) | \alpha \neq 0, \alpha \in \mathbb{R}\}$

Options :

1. ✖ A

2. ✔ B

3. ✖ C

4. ✖ D

Question Number : 24 Question Type : MCQ

The value of $\lim_{x \rightarrow \infty} (1 + x^2)^{e^{-x}}$ is

(A) 0 (B) $\frac{1}{2}$ (C) 1 (D) ∞

Options :

1. ✖ A

2. ✖ B

3. ✔ C

4. ✖ D

Question Number : 25 Question Type : NAT

The number of 4 digit numbers having their digits in non-decreasing order (from left to right) constructed by using the digits belonging to the set $\{1, 2, 3\}$ is _____.

Correct Answer :

15

Question Number : 26 Question Type : MCQ

In a room there are only two types of people, namely Type 1 and Type 2. Type 1 people always tell the truth and Type 2 people always lie. You give a fair coin to a person in that room, without knowing which type he is from and tell him to toss it and hide the result from you till you ask for it. Upon asking, the person replies the following

“The result of the toss is head if and only if I am telling the truth.”

Which of the following options is correct?

- (A) The result is head
- (B) The result is tail
- (C) If the person is of Type 2, then the result is tail
- (D) If the person is of Type 1, then the result is tail

Options :

- 1. ☒ A
- 2. ☐ B
- 3. ☐ C
- 4. ☐ D

Question Number : 27 Question Type : MCQ

While inserting the elements 71, 65, 84, 69, 67, 83 in an empty binary search tree (BST) in the sequence shown, the element in the lowest level is

- (A) 65
- (B) 67
- (C) 69
- (D) 83

Options :

- 1. ☐ A
- 2. ☒ B
- 3. ☐ C
- 4. ☐ D

Question Number : 28 Question Type : MCQ

The result evaluating the postfix expression $10\ 5\ +\ 60\ 6\ /\ * 8\ -$ is

- (A) 284
- (B) 213
- (C) 142
- (D) 71

Options :

- 1. ☐ A
- 2. ☐ B
- 3. ☒ C
- 4. ☐ D

Question Number : 29 Question Type : MCQ

Consider the following relation

Cinema(*theater, address, capacity*)

Which of the following options will be needed at the end of the SQL query

```
SELECT P1.address
FROM Cinema P1
```

such that it always finds the addresses of theaters with maximum capacity?

- (A) WHERE P1.*capacity* >= All (select P2.*capacity* from Cinema P2)
- (B) WHERE P1.*capacity* >= Any (select P2.*capacity* from Cinema P2)
- (C) WHERE P1.*capacity* > All (select max(P2.*capacity*) from Cinema P2)
- (D) WHERE P1.*capacity* > Any (select max(P2.*capacity*) from Cinema P2)

Options :

- 1. ☒ A
- 2. ☐ B
- 3. ☐ C
- 4. ☐ D

Question Number : 30 Question Type : MCQ

Consider the following array of elements.

{89, 19, 50, 17, 12, 15, 2, 5, 7, 11, 6, 9, 100}

The minimum number of interchanges needed to convert it into a max-heap is

- (A) 4 (B) 5 (C) 2 (D) 3

Options :

- 1. ☐ A
- 2. ☐ B
- 3. ☐ C
- 4. ☒ D

Question Number : 31 Question Type : MCQ

Two processes X and Y need to access a critical section. Consider the following synchronization construct used by both the processes

Process X	Process Y
<pre> /* other code for process X */ while(true) { varP = true; while(varQ == true) { /* Critical Section */ varP = false; } } /* other code for process X */ </pre>	<pre> /* other code for process Y */ while(true) { varQ = true; while(varP == true) { /* Critical Section */ varQ = false; } } /* other code for process Y */ </pre>

Here, $varP$ and $varQ$ are shared variables and both are initialized to false. Which one of the following statements is true?

- (A) The proposed solution prevents deadlock but fails to guarantee mutual exclusion
- (B) The proposed solution guarantees mutual exclusion but fails to prevent deadlock
- (C) The proposed solution guarantees mutual exclusion and prevents deadlock
- (D) The proposed solution fails to prevent deadlock and fails to guarantee mutual exclusion

Options :

- 1. ✓ A
- 2. ✗ B
- 3. ✗ C
- 4. ✗ D

Question Number : 32 Question Type : MCQ

Let L be the language represented by the regular expression $\Sigma^*0011\Sigma^*$ where $\Sigma = \{0, 1\}$. What is the minimum number of states in a DFA that recognizes \bar{L} (complement of L)?

- (A) 4
- (B) 5
- (C) 6
- (D) 8

Options :

- 1. ✗ A
- 2. ✓ B
- 3. ✗ C
- 4. ✗ D

Question Number : 33 Question Type : NAT

Consider a software program that is artificially seeded with 100 faults. While testing this program, 159 faults are detected, out of which 75 faults are from those artificially seeded faults. Assuming that both real and seeded faults are of same nature and have same distribution, the estimated number of undetected real faults is _____.

Correct Answer :

28

Question Number : 34 Question Type : MCQ

Consider a machine with a byte addressable main memory of 2^{20} bytes, block size of 16 bytes and a direct mapped cache having 2^{12} cache lines. Let the addresses of two consecutive bytes in main memory be $(E201F)_{16}$ and $(E2020)_{16}$. What are the tag and cache line address (in hex) for main memory address $(E201F)_{16}$?

- (A) E, 201 (B) F, 201 (C) E, E20 (D) 2, 01F

Options :

1. ✓ A
2. ✗ B
3. ✗ C
4. ✗ D

Question Number : 35 Question Type : MCQ

Consider a CSMA/CD network that transmits data at a rate of 100 Mbps (10^8 bits per second) over a 1 km (kilometer) cable with no repeaters. If the minimum frame size required for this network is 1250 bytes, what is the signal speed (km/sec) in the cable?

- (A) 8000 (B) 10000 (C) 16000 (D) 20000

Options :

1. ✗ A
2. ✗ B
3. ✗ C
4. ✓ D

Question Number : 36 Question Type : NAT

The velocity v (in kilometer/minute) of a motorbike which starts from rest, is given at fixed intervals of time t (in minutes) as follows:

t	2	4	6	8	10	12	14	16	18	20
v	10	18	25	29	32	20	11	5	2	0

The approximate distance (in kilometers) rounded to two places of decimals covered in 20 minutes using Simpson's $1/3^{\text{rd}}$ rule is _____.

Correct Answer :

308 to 310

Question Number : 37 Question Type : MCQ

Assume that a mergesort algorithm in the worst case takes 30 seconds for an input of size 64. Which of the following most closely approximates the maximum input size of a problem that can be solved in 6 minutes?

- (A) 256 (B) 512 (C) 1024 (D) 2048

Options :

- 1. ✖ A
- 2. ✔ B
- 3. ✖ C
- 4. ✖ D

Question Number : 38 Question Type : MCQ

Consider the following recursive C function.

```
void get(int n)
{
    if (n<1) return;
    get(n-1);
    get(n-3);
    printf("%d", n);
}
```

If get (6) function is being called in main() then how many times will the get () function be invoked before returning to the main() ?

- (A) 15 (B) 25 (C) 35 (D) 45

Options :

- 1. ✖ A
- 2. ✔ B
- 3. ✖ C
- 4. ✖ D

Question Number : 39 Question Type : NAT

Consider a B+ tree in which the search key is 12 bytes long, block size is 1024 bytes, record pointer is 10 bytes long and block pointer is 8 bytes long. The maximum number of keys that can be accommodated in each non-leaf node of the tree is _____.

Correct Answer :

50

Question Number : 40 Question Type : MCQ

Given the function $F = P' + QR$, where F is a function in three Boolean variables P, Q and R and $P' = !P$, consider the following statements.

- (S1) $F = \sum(4, 5, 6)$
- (S2) $F = \sum(0, 1, 2, 3, 7)$
- (S3) $F = \prod(4, 5, 6)$
- (S4) $F = \prod(0, 1, 2, 3, 7)$

Which of the following is true?

- (A) (S1)- False, (S2)- True, (S3)- True, (S4)- False
- (B) (S1)- True, (S2)- False, (S3)- False, (S4)- True
- (C) (S1)- False, (S2)- False, (S3)- True, (S4)- True
- (D) (S1)- True, (S2)- True, (S3)- False, (S4)- False

Options :

- 1. ☒ A
- 2. ☐ B
- 3. ☐ C
- 4. ☐ D

Question Number : 41 Question Type : MCQ

Language L_1 is polynomial time reducible to language L_2 . Language L_3 is polynomial time reducible to L_2 , which in turn is polynomial time reducible to language L_4 . Which of the following is/are true?

- I. if $L_4 \in P$, then $L_2 \in P$
- II. if $L_1 \in P$ or $L_3 \in P$, then $L_2 \in P$
- III. $L_1 \in P$, if and only if $L_3 \in P$
- IV. if $L_4 \in P$, then $L_1 \in P$ and $L_3 \in P$

- (A) II only
- (B) III only
- (C) I and IV only
- (D) I only

Options :

- 1. ☐ A
- 2. ☐ B
- 3. ☒ C
- 4. ☐ D

Question Number : 42 Question Type : NAT

Consider the following C program.

```
#include<stdio.h>
int f1(void);
int f2(void);
int f3(void);
int x = 10;

int main( )
{
    int x = 1;
    x += f1( ) + f2( ) + f3( ) + f2( );
    printf("%d", x);
    return 0;
}

int f1() { int x = 25; x++; return x;}
int f2() { static int x = 50; x++; return x;}
int f3() { x *= 10; return x};
```

The output of the program is _____.

Correct Answer :

230

Question Number : 43 Question Type : NAT

Consider the following C program.

```
#include<stdio.h>
int main( )
{
    static int a[ ] = {10, 20, 30, 40, 50};
    static int *p[ ] = {a, a+3, a+4, a+1, a+2};
    int **ptr = p;
    ptr++;
    printf("%d%d", ptr-p, **ptr);
}
```

The output of the program is _____.

Correct Answer :

140

Question Number : 44 Question Type : MCQ

Which of the following languages are context-free?

$$L_1 = \{a^m b^n a^n b^m \mid m, n \geq 1\}$$

$$L_2 = \{a^m b^n a^m b^n \mid m, n \geq 1\}$$

$$L_3 = \{a^m b^n \mid m = 2n + 1\}$$

- (A) L_1 and L_2 only (B) L_1 and L_3 only (C) L_2 and L_3 only (D) L_3 only

Options :

1. ✖ A
2. ✔ B
3. ✖ C
4. ✖ D

Question Number : 45 Question Type : MCQ

Consider the following policies for preventing deadlock in a system with mutually exclusive resources.

- I. Processes should acquire all their resources at the beginning of execution. If any resource is not available, all resources acquired so far are released
- II. The resources are numbered uniquely, and processes are allowed to request for resources only in increasing resource numbers
- III. The resources are numbered uniquely, and processes are allowed to request for resources only in decreasing resource numbers
- IV. The resources are numbered uniquely. A process is allowed to request only for a resource with resource number larger than its currently held resources

Which of the above policies can be used for preventing deadlock?

- (A) Any one of I and III but not II or IV
(B) Any one of I, III, and IV but not II
(C) Any one of II and III but not I or IV
(D) Any one of I, II, III, and IV

Options :

1. ✖ A
2. ✖ B
3. ✖ C
4. ✔ D

Question Number : 46 Question Type : NAT

In the network 200.10.11.144/27, the fourth octet (in decimal) of the last IP address of the network which can be assigned to a host is _____.

Correct Answer:

158

Question Number : 47 Question Type : NAT

Consider a network connecting two systems located 8000 kilometers apart. The bandwidth of the network is 500×10^6 bits per second. The propagation speed of the media is 4×10^6 meters per second. It is needed to design a Go-Back- N sliding window protocol for this network. The average packet size is 10^7 bits. The network is to be used to its full capacity. Assume that processing delays at nodes are negligible. Then, the minimum size in bits of the sequence number field has to be _____.

Correct Answer:

8

Question Number : 48 Question Type :NAT

Consider the following reservation table for a pipeline having three stages S_1, S_2 and S_3 .

		Time \rightarrow				
		1	2	3	4	5
S_1		X				X
S_2			X		X	
S_3				X		

The minimum average latency (MAL) is _____.

Correct Answer :

3

Question Number : 49 Question Type : MCQ

Consider the following code sequence having five instructions I_1 to I_5 . Each of these instructions has the following format.

OP Ri, Rj, Rk

where operation OP is performed on contents of registers Rj and Rk and the result is stored in register Ri.

I_1 : ADD R1, R2, R3

I_2 : MUL R7, R1, R3

I_3 : SUB R4, R1, R5

I_4 : ADD R3, R2, R4

I_5 : MUL R7, R8, R9

Consider the following three statements.

S1: There is an anti-dependence between instructions I_2 and I_5

S2: There is an anti-dependence between instructions I_2 and I_4

S3: Within an instruction pipeline an anti-dependence always creates one or more stalls

Which one of above statements is/are correct?

(A) Only S1 is true

(B) Only S2 is true

(C) Only S1 and S3 are true

(D) Only S2 and S3 are true

Options :

1. ✖ A

2. ✔ B

3. ✖ C

4. ✖ D

Question Number : 50 Question Type : MCQ

Consider the following two C code segments. Y and X are one and two dimensional arrays of size n and $n \times n$ respectively, where $2 \leq n \leq 10$. Assume that in both code segments, elements of Y are initialized to 0 and each element $X[i][j]$ of array X is initialized to $i+j$. Further assume that when stored in main memory all elements of X are in same main memory page frame.

Code segment 1:

```
//initialize elements of Y to 0
//initialize elements X[i][j] of X to i+j

for(i = 0; i < n; i++)
    Y[i] += X[0][i];
```

Code Segment 2:

```
//initialize elements of Y to 0
//initialize elements X[i][j] of X to i+j

for(i = 0; i < n; i++)
    Y[i] += X[i][0];
```

Which of the following statements is/are correct?

- S1: Final contents of array Y will be same in both code segments
- S2: Elements of array X accessed inside the for loop shown in code segment 1 are contiguous in main memory
- S3: Elements of array X accessed inside the for loop shown in code segment 2 are contiguous in main memory

- (A) Only S2 is correct
- (B) Only S3 is correct
- (C) Only S1 and S2 are correct
- (D) Only S1 and S3 are correct

Options :

- 1. ✖ A
- 2. ✖ B
- 3. ✔ C
- 4. ✖ D

Question Number : 51 Question Type : MCQ

Consider the following partial Schedule S involving two transactions $T1$ and $T2$. Only the *read* and the *write* operations have been shown. The *read* operation on data item P is denoted by $read(P)$ and the *write* operation on data item P is denoted by $write(P)$.

Time instance	Transaction-id	
	$T1$	$T2$
1	$read(A)$	
2	$write(A)$	
3		$read(C)$
4		$write(C)$
5		$read(B)$
6		$write(B)$
7		$read(A)$
8		$commit$
9	$read(B)$	

Schedule S

Suppose that the transaction $T1$ fails immediately after time instance 9. Which one of the following statements is correct?

- (A) $T2$ must be aborted and then both $T1$ and $T2$ must be re-started to ensure transaction atomicity
- (B) Schedule S is non-recoverable and cannot ensure transaction atomicity
- (C) Only $T2$ must be aborted and then re-started to ensure transaction atomicity
- (D) Schedule S is recoverable and can ensure atomicity and nothing else needs to be done

Options :

- 1. ✖ A
- 2. ✔ B
- 3. ✖ C
- 4. ✖ D

Question Number : 52 Question Type : MCQ

If the following system has non-trivial solution,

$$px + qy + rz = 0$$

$$qx + ry + pz = 0$$

$$rx + py + qz = 0,$$

then which one of the following options is TRUE?

- (A) $p - q + r = 0$ or $p = q = -r$
- (B) $p + q - r = 0$ or $p = -q = r$
- (C) $p + q + r = 0$ or $p = q = r$
- (D) $p - q + r = 0$ or $p = -q = -r$

Options :

- 1. ✖ A
- 2. ✖ B
- 3. ✔ C
- 4. ✖ D

Question Number : 53 Question Type : NAT

Consider the following C program:

```
#include<stdio.h>
int main( )
{
    int i, j, k = 0;
    j = 2 * 3 / 4 + 2.0 / 5 + 8 / 5;
    k -= --j;
    for(i = 0; i < 5; i++)
    {
        switch(i + k)
        {
            case 1:
            case 2: printf("\n%d", i+k);
            case 3: printf("\n%d", i+k);
            default: printf("\n%d", i+k);
        }
    }
    return 0;
}
```

The number of times printf statement is executed is _____.

Correct Answer:




10

Question Number : 54 Question Type : MCQ

If for non-zero x , $af(x) + bf\left(\frac{1}{x}\right) = \frac{1}{x} - 25$ where $a \neq b$ then $\int_1^2 f(x)dx$ is

- (A) $\frac{1}{a^2 - b^2} \left[a(\ln 2 - 25) + \frac{47b}{2} \right]$
- (B) $\frac{1}{a^2 - b^2} \left[a(2 \ln 2 - 25) - \frac{47b}{2} \right]$
- (C) $\frac{1}{a^2 - b^2} \left[a(2 \ln 2 - 25) + \frac{47b}{2} \right]$
- (D) $\frac{1}{a^2 - b^2} \left[a(\ln 2 - 25) - \frac{47b}{2} \right]$

Options :

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

Question Number : 55 Question Type : NAT

Let G be a connected undirected graph of 100 vertices and 300 edges. The weight of a minimum spanning tree of G is 500. When the weight of each edge of G is increased by five, the weight of a minimum spanning tree becomes _____.

Correct Answer :

995

Question Number : 56 Question Type : NAT

Two hosts are connected via a packet switch with 10^7 bits per second links. Each link has a propagation delay of 20 microseconds. The switch begins forwarding a packet 35 microseconds after it receives the same. If 10000 bits of data are to be transmitted between the two hosts using a packet size of 5000 bits, the time elapsed between the transmission of the first bit of data and the reception of the last bit of the data in microseconds is _____.

Correct Answer :

1575

Question Number : 57 Question Type : MCQ

For the processes listed in the following table, which of the following scheduling schemes will give the lowest average turnaround time?

Process	Arrival Time	Processing Time
A	0	3
B	1	6
C	4	4
D	6	2

(A) First Come First Serve

(B) Non-preemptive Shortest Job First

(C) Shortest Remaining Time

(D) Round Robin with Quantum value two

Options :

1. ✖ A

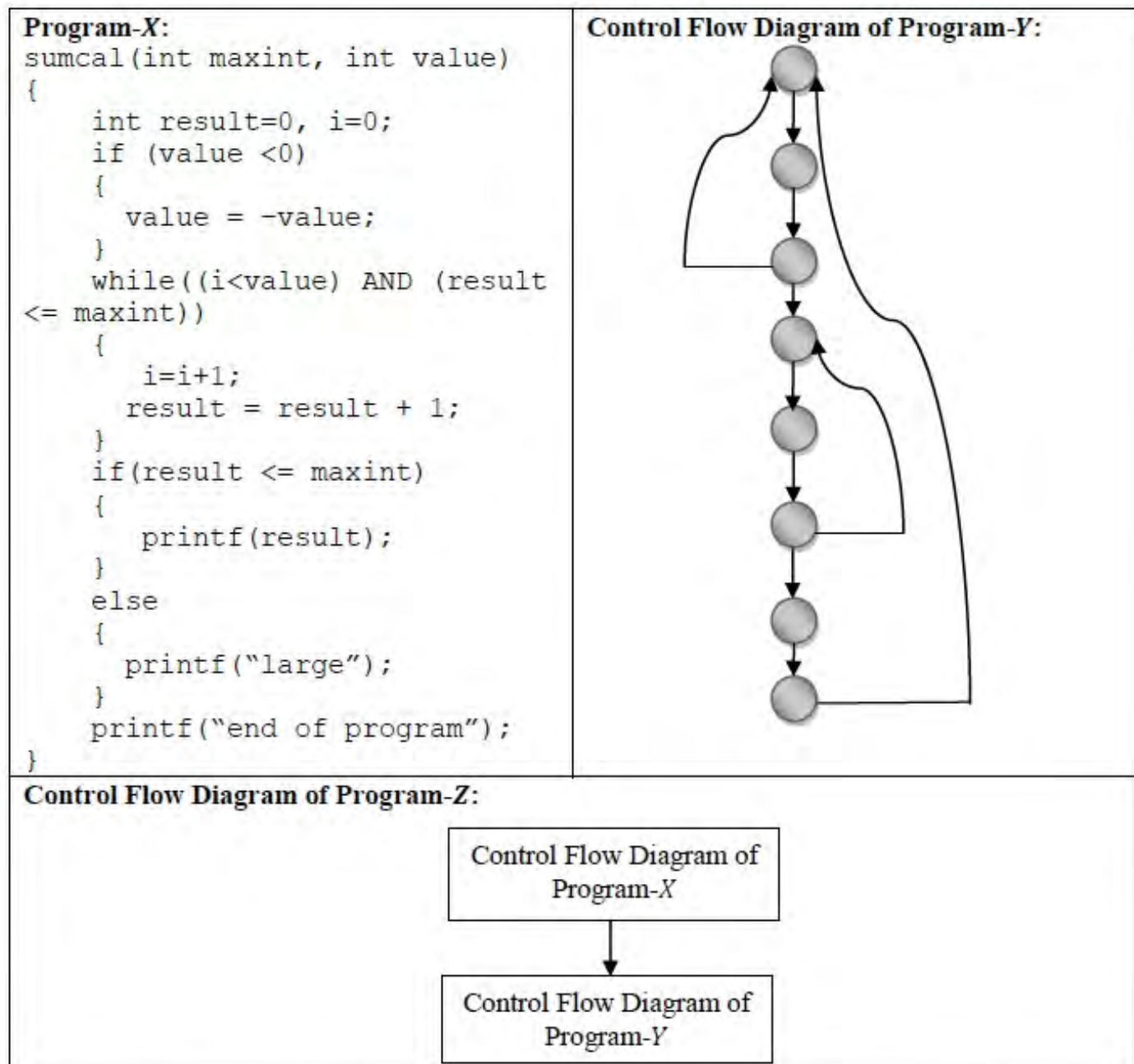
2. ✖ B

3. ✔ C

4. ✖ D

Question Number : 58 Question Type : MCQ

Consider three software items: Program-X, Control Flow Diagram of Program-Y and Control Flow Diagram of Program-Z as shown below



The values of McCabe's Cyclomatic complexity of Program-X, Program-Y, and Program-Z respectively are

- (A) 4, 4, 7 (B) 3, 4, 7 (C) 4, 4, 8 (D) 4, 3, 8

Options :

1. ✓ A
2. ✗ B
3. ✗ C
4. ✗ D

Question Number : 59 Question Type : NAT

Consider the equation $(43)_x = (y3)_8$ where x and y are unknown. The number of possible solutions is _____

Correct Answer :

5

Question Number : 60 Question Type : MCQ

Let R be a relation on the set of ordered pairs of positive integers such that $((p,q),(r,s)) \in R$ if and only if $p-s = q-r$. Which one of the following is true about R ?

(A) Both reflexive and symmetric

(B) Reflexive but not symmetric

(C) Not reflexive but symmetric

(D) Neither reflexive nor symmetric

Options :

1. ✖ A

2. ✖ B

3. ✔ C

4. ✖ D

Question Number : 61 Question Type : NAT

Suppose X_i for $i = 1, 2, 3$ are independent and identically distributed random variables whose probability mass functions are $\Pr[X_i = 0] = \Pr[X_i = 1] = 1/2$ for $i = 1, 2, 3$. Define another random variable $Y = X_1 X_2 \oplus X_3$, where \oplus denotes XOR. Then

$\Pr[Y = 0 | X_3 = 0] =$ _____.

Correct Answer :

0.75

Question Number : 62 Question Type : NAT

The total number of prime implicants of the function $f(w, x, y, z) = \sum(0, 2, 4, 5, 6, 10)$ is _____.

Correct Answer:

3

Question Number : 63 Question Type : NAT

Suppose $c = \langle c[0], \dots, c[k-1] \rangle$ is an array of length k , where all the entries are from the set $\{0, 1\}$. For any positive integers a and n , consider the following pseudocode.

```
DOSOMETHING( $c, a, n$ )
 $z \leftarrow 1$ 
for  $i \leftarrow 0$  to  $k-1$ 
    do  $z \leftarrow z^2 \bmod n$ 
    if  $c[i] = 1$ 
        then  $z \leftarrow (z \times a) \bmod n$ 
return  $z$ 
```

If $k = 4$, $c = \langle 1, 0, 1, 1 \rangle$, $a = 2$ and $n = 8$, then the output of $\text{DOSOMETHING}(c, a, n)$ is

Correct Answer :

0

Question Number : 64 Question Type : MCQ

Let $f(n) = n$ and $g(n) = n^{(1+\sin n)}$, where n is a positive integer. Which of the following statements is/are correct?

- I. $f(n) = O(g(n))$
- II. $f(n) = \Omega(g(n))$

- (A) Only I
- (B) Only II
- (C) Both I and II
- (D) Neither I nor II

Options :

- 1. ✖ A
- 2. ✖ B
- 3. ✖ C
- 4. ✔ D

Question Number : 65 Question Type : MCQ

Consider the following grammar G

$$\begin{aligned} S &\rightarrow F \mid H \\ F &\rightarrow p \mid c \\ H &\rightarrow d \mid c \end{aligned}$$

where S, F , and H are non-terminal symbols, p, d , and c are terminal symbols. Which of the following statement(s) is/are correct?

S1. LL(1) can parse all strings that are generated using grammar G

S2. LR(1) can parse all strings that are generated using grammar G

(A) Only S1 (B) Only S2 (C) Both S1 and S2 (D) Neither S1 nor S2

Options :

1. ✖ A

2. ✖ B


3. ✖ C


4. ✔ D


GATE
Computer Science and
Information Technology
Engineering
Question Paper
2014
(with Solutions)


GATE 2014: General Instructions during Examination


1. Total duration of the GATE examination is **180** minutes.
2. The clock will be set at the server. The countdown timer at the top right corner of screen will display the remaining time available for you to complete the examination. When the timer reaches zero, the examination will end by itself. You need not terminate the examination or submit your paper.
3. Any useful data required for your paper can be viewed by clicking on the **Useful Common Data** button that appears on the screen.
4. Use the scribble pad provided to you for any rough work. Submit the scribble pad at the end of the examination.
5. You are allowed to use a non-programmable type calculator, however, sharing of calculators is not allowed.
6. The Question Palette displayed on the right side of screen will show the status of each question using one of the following symbols:

 1 You have not visited the question yet.

 3 You have not answered the question.

 5 You have answered the question.

 7 You have NOT answered the question, but have marked the question for review.

 9 You have answered the question, but marked it for review.

The **Marked for Review** status for a question simply indicates that you would like to look at that question again. *If a question is answered, but marked for review, then the answer will be considered for evaluation unless the status is modified by the candidate.*

Navigating to a Question :

7. To answer a question, do the following:
 - a. Click on the question number in the Question Palette to go to that question directly.
 - b. Select an answer for a multiple choice type question by clicking on the bubble placed before the 4 choices, namely A, B, C and D. Use the virtual numeric keypad to enter a number as answer for a numerical type question.
 - c. Click on **Save & Next** to save your answer for the current question and then go to the next question.
 - d. Click on **Mark for Review & Next** to save your answer for the current question and also mark it for review, and then go to the next question.

Caution: Note that your answer for the current question will not be saved, if you navigate to another question directly by clicking on a question number without saving the answer to the previous question.

You can view all the questions by clicking on the **Question Paper** button. This feature is provided, so that if you want you can just see the entire question paper at a glance.

Answering a Question :

8. Procedure for answering a multiple choice (MCQ) type question:
 - a. Choose one answer from the 4 options (A,B,C,D) given below the question, click on the bubble placed before the chosen option.
 - b. To deselect your chosen answer, click on the bubble of the chosen option again or click on the **Clear Response** button.
 - c. To change your chosen answer, click on the bubble of another option.
 - d. To save your answer, you MUST click on the **Save & Next** button.
9. Procedure for answering a numerical answer type question:
 - a. To enter a number as your answer, use the virtual numerical keypad.
 - b. A fraction (e.g. -0.3 or -.3) can be entered as an answer with or without '0' before the decimal point. As many as four decimal points, e.g. 12.5435 or 0.003 or -932.6711 or 12.82 can be entered.
 - c. To clear your answer, click on the **Clear Response** button.
 - d. To save your answer, you MUST click on the **Save & Next** button
10. To mark a question for review, click on the **Mark for Review & Next** button. *If an answer is selected (for MCQ) or entered (for numerical answer type) for a question that is **Marked for Review**, that answer will be considered in the evaluation unless the status is modified by the candidate.*
11. To change your answer to a question that has already been answered, first select that question for answering and then follow the procedure for answering that type of question.
12. Note that ONLY Questions for which answers are ***saved*** or ***marked for review after answering*** will be considered for evaluation.

Choosing a Section :

13. Sections in this question paper are displayed on the top bar of the screen. Questions in a Section can be viewed by clicking on the name of that Section. The Section you are currently viewing will be highlighted.
14. A checkbox is displayed for every optional Section, if any, in the Question Paper. To select the optional Section for answering, click on the checkbox for that Section.
15. If the checkbox for an optional Section is not selected, the **Save & Next** button and the **Mark for Review & Next** button will NOT be enabled for that Section. You will

only be able to see questions in this Section, but you will not be able to answer questions in the Section.

16. After clicking the **Save & Next** button for the last question in a Section, you will automatically be taken to the first question of the next Section in sequence.
17. You can move the mouse cursor over the name of a Section to view the answering status for that Section.

Changing the Optional Section :

18. After answering the chosen optional Section, partially or completely, you can change the optional Section by selecting the checkbox for a new Section that you want to attempt. A warning message will appear along with a table showing the number of questions answered in each of the previously chosen optional Sections and a checkbox against each of these Sections. Click on a checkbox against a Section that you want to reset and then click on the **RESET** button. Note that RESETTING a Section will DELETE all the answers for questions in that Section. Hence, if you think that you may want to select this Section again later, you will have to note down your answers for questions in that Section. If you do not want to reset the Section and want to continue answering the previously chosen optional Section, then click on the **BACK** button.
19. If you deselect the checkbox for an optional Section in the top bar, the following warning message will appear: "Deselecting the checkbox will DELETE all the answers for questions in this Section. Do you want to deselect this Section?" If you want to deselect, click on the **RESET** button. If you do not want to deselect, click on the **BACK** button.
20. You can shuffle between different Sections or change the optional Sections any number of times.

GATE 2014 Examination

CS: Computer Science & Information Technology

Duration: 180 minutes

Maximum Marks: 100

Read the following instructions carefully.

1. To login, enter your Registration Number and password provided to you. Kindly go through the various symbols used in the test and understand their meaning before you start the examination.
2. Once you login and after the start of the examination, you can view all the questions in the question paper, by clicking on the **View All Questions** button in the screen.
3. This question paper consists of **2 sections**, General Aptitude (GA) for **15 marks** and the subject specific GATE paper for **85 marks**. Both these sections are compulsory.
The GA section consists of **10** questions. Question numbers 1 to 5 are of 1-mark each, while question numbers 6 to 10 are of 2-mark each.
The subject specific GATE paper section consists of **55** questions, out of which question numbers 1 to 25 are of 1-mark each, while question numbers 26 to 55 are of 2-mark each.
4. Depending upon the GATE paper, there may be useful common data that may be required for answering the questions. If the paper has such useful data, the same can be viewed by clicking on the **Useful Common Data** button that appears at the top, right hand side of the screen.
5. The computer allotted to you at the examination center runs specialized software that permits only one answer to be selected for multiple-choice questions using a mouse and to enter a suitable number for the numerical answer type questions using the virtual keyboard and mouse.
6. Your answers shall be updated and saved on a server periodically and also at the end of the examination. The examination will **stop automatically** at the end of **180 minutes**.
7. In each paper a candidate can answer a total of 65 questions carrying 100 marks.
8. The question paper may consist of questions of **multiple choice type (MCQ)** and **numerical answer type**.
9. Multiple choice type questions will have four choices against A, B, C, D, out of which only **ONE** is the correct answer. The candidate has to choose the correct answer by clicking on the bubble (○) placed before the choice.
10. For numerical answer type questions, each question will have a numerical answer and there will not be any choices. **For these questions, the answer should be entered** by using the virtual keyboard that appears on the monitor and the mouse.
11. All questions that are not attempted will result in zero marks. However, wrong answers for multiple choice type questions (MCQ) will result in **NEGATIVE** marks. For all MCQ questions a wrong answer will result in deduction of $\frac{1}{3}$ marks for a 1-mark question and $\frac{2}{3}$ marks for a 2-mark question.
12. There is **NO NEGATIVE MARKING** for questions of **NUMERICAL ANSWER TYPE**.
13. Non-programmable type Calculator is allowed. Charts, graph sheets, and mathematical tables are **NOT** allowed in the Examination Hall. You must use the Scribble pad provided to you at the examination centre for all your rough work. The Scribble Pad has to be returned at the end of the examination.

Declaration by the candidate:

“I have read and understood all the above instructions. I have also read and understood clearly the instructions given on the admit card and shall follow the same. I also understand that in case I am found to violate any of these instructions, my candidature is liable to be cancelled. I also confirm that at the start of the examination all the computer hardware allotted to me are in proper working condition”.

GATE 2014**SET- 9****General Aptitude -GA****Q. 1 – Q. 5 carry one mark each.**

- Q.1 While trying to collect an envelope from under the table, Mr. X fell down and was losing consciousness.

I

II

III

IV

Which one of the above underlined parts of the sentence is NOT appropriate?

- (A) I (B) II (C) III (D) IV
- Q.2 If she _____ how to calibrate the instrument, she _____ done the experiment.
- (A) knows, will have (B) knew, had
(C) had known, could have (D) should have known, would have
- Q.3 Choose the word that is opposite in meaning to the word “coherent”.
- (A) sticky (B) well-connected (C) rambling (D) friendly
- Q.4 Which number does not belong in the series below?
2, 5, 10, 17, 26, 37, 50, 64
- (A) 17 (B) 37 (C) 64 (D) 26
- Q.5 The table below has question-wise data on the performance of students in an examination. The marks for each question are also listed. There is no negative or partial marking in the examination.

Q No.	Marks	Answered Correctly	Answered Wrongly	Not Attempted
1	2	21	17	6
2	3	15	27	2
3	2	23	18	3

What is the average of the marks obtained by the class in the examination?

- (A) 1.34 (B) 1.74 (C) 3.02 (D) 3.91
- Q. 6 – Q. 10 carry two marks each.**

- Q.6 A dance programme is scheduled for 10.00 a.m. Some students are participating in the programme and they need to come an hour earlier than the start of the event. These students should be accompanied by a parent. Other students and parents should come in time for the programme. The instruction you think that is appropriate for this is
- (A) Students should come at 9.00 a.m. and parents should come at 10.00 a.m.
(B) Participating students should come at 9.00 a.m. accompanied by a parent, and other parents and students should come by 10.00 a.m.
(C) Students who are not participating should come by 10.00 a.m. and they should not bring their parents. Participating students should come at 9.00 a.m.
(D) Participating students should come before 9.00 a.m. Parents who accompany them should come at 9.00 a.m. All others should come at 10.00 a.m.

GATE 2014

SET- 9

General Aptitude -GA

- Q.7 By the beginning of the 20th century, several hypotheses were being proposed, suggesting a paradigm shift in our understanding of the universe. However, the clinching evidence was provided by experimental measurements of the position of a star which was directly behind our sun.

Which of the following inference(s) may be drawn from the above passage?

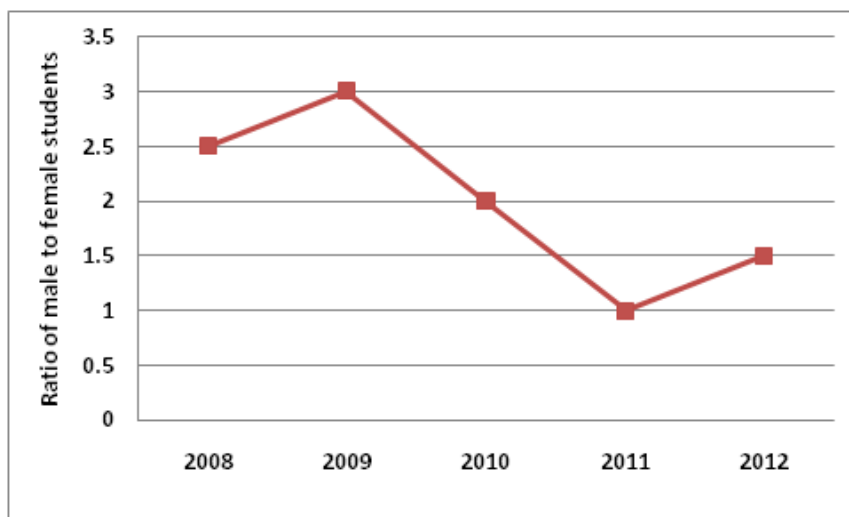
- (i) Our understanding of the universe changes based on the positions of stars
- (ii) Paradigm shifts usually occur at the beginning of centuries
- (iii) Stars are important objects in the universe
- (iv) Experimental evidence was important in confirming this paradigm shift

(A) (i), (ii) and (iv) (B) (iii) only (C) (i) and (iv) (D) (iv) only

- Q.8 The Gross Domestic Product (GDP) in Rupees grew at 7% during 2012-2013. For international comparison, the GDP is compared in US Dollars (USD) after conversion based on the market exchange rate. During the period 2012-2013 the exchange rate for the USD increased from Rs. 50/ USD to Rs. 60/ USD. India's GDP in USD during the period 2012-2013

- (A) increased by 5 % (B) decreased by 13%
(C) decreased by 20% (D) decreased by 11%

- Q.9 The ratio of male to female students in a college for five years is plotted in the following line graph. If the number of female students in 2011 and 2012 is equal, what is the ratio of male students in 2012 to male students in 2011?



- (A) 1:1 (B) 2:1 (C) 1.5:1 (D) 2.5:1

- Q.10 Consider the equation: $(7526)_8 - (Y)_8 = (4364)_8$, where $(X)_N$ stands for X to the base N. Find Y.

- (A) 1634 (B) 1737 (C) 3142 (D) 3162

END OF THE QUESTION PAPER

Q. 1 – Q. 25 carry one mark each.

Q.1 Consider the following statements:

P: Good mobile phones are not cheap
Q: Cheap mobile phones are not good

L: P implies Q
M: Q implies P
N: P is equivalent to Q

Which one of the following about L, M, and N is **CORRECT**?

- (A) Only L is TRUE.
- (B) Only M is TRUE.
- (C) Only N is TRUE.
- (D) L, M and N are TRUE.

Q.2 Let X and Y be finite sets and $f: X \rightarrow Y$ be a function. Which one of the following statements is TRUE?

- (A) For any subsets A and B of X , $|f(A \cup B)| = |f(A)| + |f(B)|$
- (B) For any subsets A and B of X , $f(A \cap B) = f(A) \cap f(B)$
- (C) For any subsets A and B of X , $|f(A \cap B)| = \min \{|f(A)|, |f(B)|\}$
- (D) For any subsets S and T of Y , $f^{-1}(S \cap T) = f^{-1}(S) \cap f^{-1}(T)$

Q.3 Let G be a group with 15 elements. Let L be a subgroup of G . It is known that $L \neq G$ and that the size of L is at least 4. The size of L is _____.

Q.4 Which one of the following statements is TRUE about every $n \times n$ matrix with only real eigenvalues?

- (A) If the trace of the matrix is positive and the determinant of the matrix is negative, at least one of its eigenvalues is negative.
- (B) If the trace of the matrix is positive, all its eigenvalues are positive.
- (C) If the determinant of the matrix is positive, all its eigenvalues are positive.
- (D) If the product of the trace and determinant of the matrix is positive, all its eigenvalues are positive.

GATE 2014

SET-3

COMPUTER – CS

Q.5 If V_1 and V_2 are 4-dimensional subspaces of a 6-dimensional vector space V , then the smallest possible dimension of $V_1 \cap V_2$ is _____.

Q.6 If $\int_0^{2\pi} |x \sin x| dx = k\pi$, then the value of k is equal to _____.

Q.7 Consider the following minterm expression for F :

$$F(P, Q, R, S) = \sum 0, 2, 5, 7, 8, 10, 13, 15$$

The minterms 2, 7, 8 and 13 are 'do not care' terms. The minimal sum-of-products form for F is

(A) $Q\bar{S} + \bar{Q}S$

(B) $\bar{Q}\bar{S} + QS$

(C) $\bar{Q}\bar{R}\bar{S} + \bar{Q}R\bar{S} + Q\bar{R}S + QRS$

(D) $\bar{P}\bar{Q}\bar{S} + \bar{P}QS + PQS + P\bar{Q}\bar{S}$

Q.8 Consider the following combinational function block involving four Boolean variables x , y , a , b where x , a , b are inputs and y is the output.

```
f(x, y, a, b)
{
    if (x is 1) y = a;
    else y = b;
}
```

Which one of the following digital logic blocks is the most suitable for implementing this function?

(A) Full adder (B) Priority encoder (C) Multiplexor (D) Flip-flop

Q.9 Consider the following processors (ns stands for nanoseconds). Assume that the pipeline registers have zero latency.

P1: Four-stage pipeline with stage latencies 1 ns, 2 ns, 2 ns, 1 ns.

P2: Four-stage pipeline with stage latencies 1 ns, 1.5 ns, 1.5 ns, 1.5 ns.

P3: Five-stage pipeline with stage latencies 0.5 ns, 1 ns, 1 ns, 0.6 ns, 1 ns.

P4: Five-stage pipeline with stage latencies 0.5 ns, 0.5 ns, 1 ns, 1 ns, 1.1 ns.

Which processor has the highest peak clock frequency?

(A) P1 (B) P2 (C) P3 (D) P4

GATE 2014

SET-3

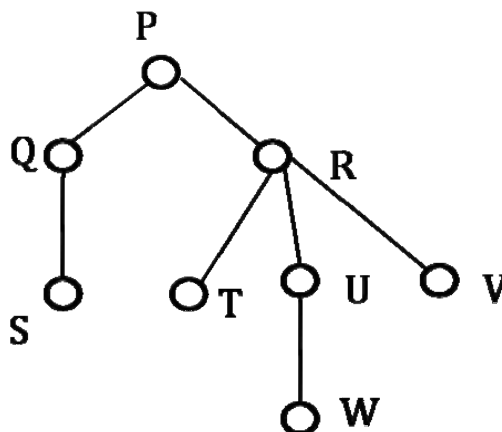
COMPUTER – CS

- Q.10 Let A be a square matrix of size $n \times n$. Consider the following pseudocode. What is the expected output?

```
C = 100;
for i = 1 to n do
  for j = 1 to n do
    {
      Temp = A[i][j] + C;
      A[i][j] = A[j][i];
      A[j][i] = Temp - C;
    }
  for i = 1 to n do
    for j = 1 to n do
      output (A[i][j]);
```

- (A) The matrix A itself
- (B) Transpose of the matrix A
- (C) Adding 100 to the upper diagonal elements and subtracting 100 from lower diagonal elements of A
- (D) None of the above
- Q.11 The minimum number of arithmetic operations required to evaluate the polynomial $P(X) = X^5 + 4X^3 + 6X + 5$ for a given value of X , using only one temporary variable is _____.

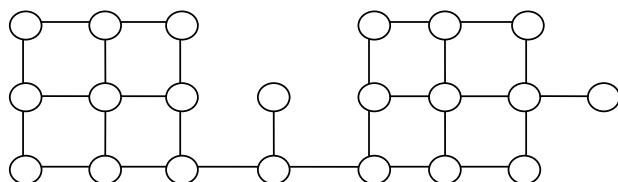
- Q.12 Consider the following rooted tree with the vertex labeled P as the root:



The order in which the nodes are visited during an in-order traversal of the tree is

- (A) SQPTRWUV
- (B) SQPTUWRV
- (C) SQPTWUVR
- (D) SQPTRUWV

- Q.13 Suppose depth first search is executed on the graph below starting at some unknown vertex. Assume that a recursive call to visit a vertex is made only after first checking that the vertex has not been visited earlier. Then the maximum possible recursion depth (including the initial call) is _____.



- Q.14 You have an array of n elements. Suppose you implement quicksort by always choosing the central element of the array as the pivot. Then the tightest upper bound for the worst case performance is
- (A) $O(n^2)$ (B) $O(n \log n)$ (C) $\Theta(n \log n)$ (D) $O(n^3)$
- Q.15 The length of the shortest string NOT in the language (over $\Sigma = \{a, b\}$) of the following regular expression is _____.

$$a^*b^*(ba)^*a^*$$

- Q.16 Let Σ be a finite non-empty alphabet and let 2^{Σ^*} be the power set of Σ^* . Which one of the following is **TRUE**?
- (A) Both 2^{Σ^*} and Σ^* are countable (B) 2^{Σ^*} is countable and Σ^* is uncountable
(C) 2^{Σ^*} is uncountable and Σ^* is countable (D) Both 2^{Σ^*} and Σ^* are uncountable
- Q.17 One of the purposes of using intermediate code in compilers is to
- (A) make parsing and semantic analysis simpler.
(B) improve error recovery and error reporting.
(C) increase the chances of reusing the machine-independent code optimizer in other compilers.
(D) improve the register allocation.

Q.18 Which of the following statements are CORRECT?

- 1) Static allocation of all data areas by a compiler makes it impossible to implement recursion.
- 2) Automatic garbage collection is essential to implement recursion.
- 3) Dynamic allocation of activation records is essential to implement recursion.
- 4) Both heap and stack are essential to implement recursion.

(A) 1 and 2 only (B) 2 and 3 only (C) 3 and 4 only (D) 1 and 3 only

Q.19 In the context of modular software design, which one of the following combinations is desirable?

- (A) High cohesion and high coupling
- (B) High cohesion and low coupling
- (C) Low cohesion and high coupling
- (D) Low cohesion and low coupling

Q.20 A system uses 3 page frames for storing process pages in main memory. It uses the Least Recently Used (**LRU**) page replacement policy. Assume that all the page frames are initially empty. What is the total number of page faults that will occur while processing the page reference string given below?

4, 7, 6, 1, 7, 6, 1, 2, 7, 2

Q.21 What is the optimized version of the relation algebra expression $\pi_{A1}(\pi_{A2}(\sigma_{F1}(\sigma_{F2}(r))))$, where $A1, A2$ are sets of attributes in r with $A1 \subset A2$ and $F1, F2$ are Boolean expressions based on the attributes in r ?

- (A) $\pi_{A1}(\sigma_{(F1 \wedge F2)}(r))$
- (B) $\pi_{A1}(\sigma_{(F1 \vee F2)}(r))$
- (C) $\pi_{A2}(\sigma_{(F1 \wedge F2)}(r))$
- (D) $\pi_{A2}(\sigma_{(F1 \vee F2)}(r))$

Q.22 A *prime attribute* of a relation scheme R is an attribute that appears

- (A) in all candidate keys of R .
- (B) in some candidate key of R .
- (C) in a foreign key of R .
- (D) only in the primary key of R .

- Q.23 In the following pairs of OSI protocol layer/sub-layer and its functionality, the **INCORRECT** pair is
- (A) Network layer and Routing
 - (B) Data Link Layer and Bit synchronization
 - (C) Transport layer and End-to-end process communication
 - (D) Medium Access Control sub-layer and Channel sharing
- Q.24 A bit-stuffing based framing protocol uses an 8-bit delimiter pattern of 01111110. If the output bit-string after stuffing is 01111100101, then the input bit-string is
- (A) 0111110100
 - (B) 0111110101
 - (C) 0111111101
 - (D) 0111111111
- Q.25 Host A (on TCP/IP v4 network A) sends an IP datagram D to host B (also on TCP/IP v4 network B). Assume that no error occurred during the transmission of D. When D reaches B, 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)

Q. 26 – Q. 55 carry two marks each.

- Q.26 An IP router implementing Classless Inter-domain Routing (CIDR) receives a packet with address 131.23.151.76. The router's routing table has the following entries:

Prefix	Output Interface Identifier
131.16.0.0/ 12	3
131.28.0.0/ 14	5
131.19.0.0/ 16	2
131.22.0.0/ 15	1

The identifier of the output interface on which this packet will be forwarded is _____.

Q.27 Every host in an IPv4 network has a 1-second resolution real-time clock with battery backup. Each host needs to generate up to 1000 unique identifiers per second. Assume that each host has a globally unique IPv4 address. Design a 50-bit globally unique ID for this purpose. After what period (in seconds) will the identifiers generated by a host wrap around?

Q.28 An IP router with a Maximum Transmission Unit (MTU) of 1500 bytes has received an IP packet of size 4404 bytes with an IP header of length 20 bytes. The values of the relevant fields in the header of the third IP fragment generated by the router for this packet are

- (A) MF bit: 0, Datagram Length: 1444; Offset: 370
- (B) MF bit: 1, Datagram Length: 1424; Offset: 185
- (C) MF bit: 1, Datagram Length: 1500; Offset: 370
- (D) MF bit: 0, Datagram Length: 1424; Offset: 2960

Q.29 Consider the transactions **T1**, **T2**, and **T3** and the schedules **S1** and **S2** given below.

T1: **r1(X); r1(Z); w1(X); w1(Z)**

T2: **r2(Y); r2(Z); w2(Z)**

T3: **r3(Y); r3(X); w3(Y)**

S1: **r1(X); r3(Y); r3(X); r2(Y); r2(Z); w3(Y); w2(Z); r1(Z); w1(X); w1(Z)**

S2: **r1(X); r3(Y); r2(Y); r3(X); r1(Z); r2(Z); w3(Y); w1(X); w2(Z); w1(Z)**

Which one of the following statements about the schedules is **TRUE**?

- (A) Only **S1** is conflict-serializable.
- (B) Only **S2** is conflict-serializable.
- (C) Both **S1** and **S2** are conflict-serializable.
- (D) Neither **S1** nor **S2** is conflict-serializable.

Q.30 Consider the relational schema given below, where **eId** of the relation **dependent** is a foreign key referring to **empId** of the relation **employee**. Assume that every employee has at least one associated dependent in the **dependent** relation.

employee (**empId**, **empName**, **empAge**)

dependent (**depId**, **eId**, **depName**, **depAge**)

Consider the following relational algebra query:

$\Pi_{\text{empId}}(\text{employee}) - \Pi_{\text{empId}}(\text{employee} \bowtie_{(\text{empId} = \text{eId}) \wedge (\text{empAge} \leq \text{depAge})} \text{dependent})$

The above query evaluates to the set of **empIds** of employees whose age is greater than that of

- (A) some dependent.
- (B) all dependents.
- (C) some of his/her dependents.
- (D) all of his/her dependents.

- Q.31 A system contains three programs and each requires three tape units for its operation. The minimum number of tape units which the system must have such that deadlocks never arise is _____.
- Q.32 An operating system uses *shortest remaining time first* scheduling algorithm for pre-emptive scheduling of processes. Consider the following set of processes with their arrival times and CPU burst times (in milliseconds):

Process	Arrival Time	Burst Time
P1	0	12
P2	2	4
P3	3	6
P4	8	5

- The average waiting time (in milliseconds) of the processes is _____.
- Q.33 Consider a paging hardware with a TLB. Assume that the entire page table and all the pages are in the physical memory. It takes 10 milliseconds to search the TLB and 80 milliseconds to access the physical memory. If the TLB hit ratio is 0.6, the effective memory access time (in milliseconds) is _____.
- Q.34 Consider the basic block given below.

$a = b + c$
 $c = a + d$
 $d = b + c$
 $e = d - b$
 $a = e + b$

The minimum number of nodes and edges present in the DAG representation of the above basic block respectively are

- (A) 6 and 6 (B) 8 and 10 (C) 9 and 12 (D) 4 and 4
- Q.35 Which one of the following problems is undecidable?
- (A) Deciding if a given context-free grammar is ambiguous.
(B) Deciding if a given string is generated by a given context-free grammar.
(C) Deciding if the language generated by a given context-free grammar is empty.
(D) Deciding if the language generated by a given context-free grammar is finite.

GATE 2014

SET-3

COMPUTER – CS

Q.36 Consider the following languages over the alphabet $\Sigma = \{0,1,c\}$:

$$L_1 = \{0^n 1^n \mid n \geq 0\}$$

$$L_2 = \{wcw^r \mid w \in \{0,1\}^*\}$$

$$L_3 = \{ww^r \mid w \in \{0,1\}^*\}$$

Here, w^r is the reverse of the string w . Which of these languages are deterministic Context-free languages?

- (A) None of the languages
- (B) Only L_1
- (C) Only L_1 and L_2
- (D) All the three languages

Q.37 Suppose you want to move from 0 to 100 on the number line. In each step, you either move right by a unit distance or you take a *shortcut*. A shortcut is simply a pre-specified pair of integers i, j with $i < j$. Given a shortcut i, j if you are at position i on the number line, you may directly move to j . Suppose $T(k)$ denotes the smallest number of steps needed to move from k to 100. Suppose further that there is at most 1 shortcut involving any number, and in particular from 9 there is a shortcut to 15. Let y and z be such that $T(9) = 1 + \min(T(y), T(z))$. Then the value of the product yz is ____.

Q.38 Consider the decision problem $2CNFSAT$ defined as follows:

$\{\Phi \mid \Phi \text{ is a satisfiable propositional formula in CNF with at most two literals per clause}\}$

For example, $\Phi = (x_1 \vee x_2) \wedge (x_1 \vee \bar{x}_3) \wedge (x_2 \vee x_4)$ is a Boolean formula and it is in $2CNFSAT$.

The decision problem $2CNFSAT$ is

- (A) NP-Complete.
- (B) solvable in polynomial time by reduction to directed graph reachability.
- (C) solvable in constant time since any input instance is satisfiable.
- (D) NP-hard, but not NP-complete.

Q.39 Suppose we have a balanced binary search tree T holding n numbers. We are given two numbers L and H and wish to sum up all the numbers in T that lie between L and H . Suppose there are m such numbers in T . If the tightest upper bound on the time to compute the sum is $O(n^a \log^b n + m^c \log^d n)$, the value of $a + 10b + 100c + 1000d$ is ____.

GATE 2014

SET-3

COMPUTER – CS

Q.40 Consider a hash table with 100 slots. 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) $(97 \times 97 \times 97)/100^3$ (B) $(99 \times 98 \times 97)/100^3$
(C) $(97 \times 96 \times 95)/100^3$ (D) $(97 \times 96 \times 95)/(3! \times 100^3)$

Q.41 Consider the pseudocode given below. The function **DoSomething()** takes as argument a pointer to the root of an arbitrary tree represented by the *leftMostChild-rightSibling* representation. Each node of the tree is of type **treeNode**.

```
typedef struct treeNode* treeptr;

struct treeNode
{
    treeptr leftMostChild, rightSibling;
};

int DoSomething (treeptr tree)
{
    int value=0;
    if (tree != NULL) {
        if (tree->leftMostChild == NULL)
            value = 1;
        else
            value = DoSomething(tree->leftMostChild);
        value = value + DoSomething(tree->rightSibling);
    }
    return(value);
}
```

When the pointer to the root of a tree is passed as the argument to **DoSomething**, the value returned by the function corresponds to the

- (A) number of internal nodes in the tree.
(B) height of the tree.
(C) number of nodes without a right sibling in the tree.
(D) number of leaf nodes in the tree.

- Q.42 Consider the C function given below. Assume that the array **listA** contains **n** (> 0) elements, sorted in ascending order.

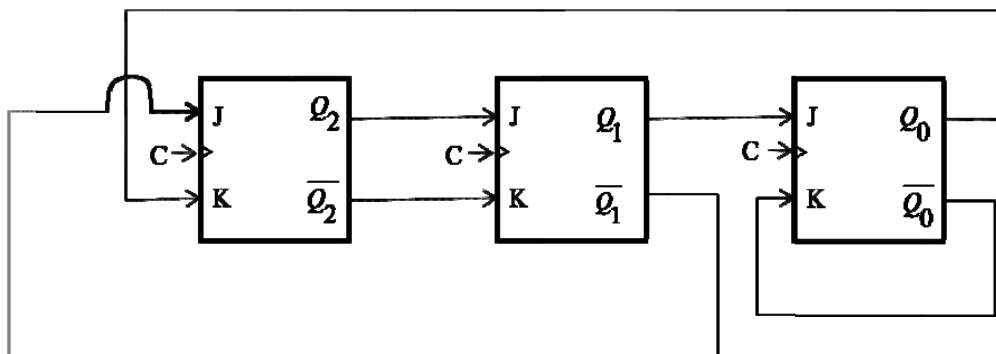
```
int ProcessArray(int *listA, int x, int n)
{
    int i, j, k;
    i = 0;
    j = n-1;
    do {
        k = (i+j)/2;
        if (x <= listA[k])
            j = k-1;
        if (listA[k] <= x)
            i = k+1;
    }while (i <= j);

    if (listA[k] == x)
        return(k);
    else
        return -1;
}
```

Which one of the following statements about the function **ProcessArray** is **CORRECT**?

- (A) It will run into an infinite loop when **x** is not in **listA**.
- (B) It is an implementation of binary search.
- (C) It will always find the maximum element in **listA**.
- (D) It will return -1 even when **x** is present in **listA**.
- Q.43 An instruction pipeline has five stages, namely, instruction fetch (IF), instruction decode and register fetch (ID/RF), instruction execution (EX), memory access (MEM), and register writeback (WB) with stage latencies 1 ns, 2.2 ns, 2 ns, 1 ns, and 0.75 ns, respectively (ns stands for nanoseconds). To gain in terms of frequency, the designers have decided to split the ID/RF stage into three stages (ID, RF1, RF2) each of latency 2.2/3 ns. Also, the EX stage is split into two stages (EX1, EX2) each of latency 1 ns. The new design has a total of eight pipeline stages. A program has 20% branch instructions which execute in the EX stage and produce the next instruction pointer at the end of the EX stage in the old design and at the end of the EX2 stage in the new design. The IF stage stalls after fetching a branch instruction until the next instruction pointer is computed. All instructions other than the branch instruction have an average CPI of one in both the designs. The execution times of this program on the old and the new design are P and Q nanoseconds, respectively. The value of P/Q is _____.
- Q.44 The memory access time is 1 nanosecond for a read operation with a hit in cache, 5 nanoseconds for a read operation with a miss in cache, 2 nanoseconds for a write operation with a hit in cache and 10 nanoseconds for a write operation with a miss in cache. Execution of a sequence of instructions involves 100 instruction fetch operations, 60 memory operand read operations and 40 memory operand write operations. The cache hit-ratio is 0.9. The average memory access time (in nanoseconds) in executing the sequence of instructions is _____.

Q.45



The above synchronous sequential circuit built using JK flip-flops is initialized with $Q_2Q_1Q_0 = 000$. The state sequence for this circuit for the next 3 clock cycles is

- (A) 001, 010, 011
- (B) 111, 110, 101
- (C) 100, 110, 111
- (D) 100, 011, 001

Q.46 With respect to the numerical evaluation of the definite integral, $K = \int_a^b x^2 dx$, where a and b are given, which of the following statements is/are TRUE?

- I) The value of K obtained using the trapezoidal rule is always greater than or equal to the exact value of the definite integral.
- II) The value of K obtained using the Simpson's rule is always equal to the exact value of the definite integral.

- (A) I only
- (B) II only
- (C) Both I and II
- (D) Neither I nor II

Q.47 The value of the integral given below is

$$\int_0^{\pi} x^2 \cos x dx$$

- (A) -2π
- (B) π
- (C) $-\pi$
- (D) 2π

Q.48 Let S be a sample space and two mutually exclusive events A and B be such that $A \cup B = S$. If $P(\cdot)$ denotes the probability of the event, the maximum value of $P(A)P(B)$ is _____.

GATE 2014

SET-3

COMPUTER – CS

Q.49 Consider the set of all functions $f: \{0,1, \dots, 2014\} \rightarrow \{0,1, \dots, 2014\}$ such that $f(f(i)) = i$, for all $0 \leq i \leq 2014$. Consider the following statements:

P . For each such function it must be the case that for every i , $f(i) = i$.

Q . For each such function it must be the case that for some i , $f(i) = i$.

R . Each such function must be onto.

Which one of the following is CORRECT?

(A) P , Q and R are true

(B) Only Q and R are true

(C) Only P and Q are true

(D) Only R is true

Q.50 There are two elements x, y in a group $(G, *)$ such that every element in the group can be written as a product of some number of x 's and y 's in some order. It is known that

$$x * x = y * y = x * y * x * y = y * x * y * x = e$$

where e is the identity element. The maximum number of elements in such a group is _____.

Q.51 If G is a forest with n vertices and k connected components, how many edges does G have?

(A) $\lfloor n/k \rfloor$

(B) $\lfloor n/k \rfloor$

(C) $n - k$

(D) $n - k + 1$

Q.52 Let δ denote the minimum degree of a vertex in a graph. For all planar graphs on n vertices with $\delta \geq 3$, which one of the following is **TRUE**?

(A) In any planar embedding, the number of faces is at least $\frac{n}{2} + 2$

(B) In any planar embedding, the number of faces is less than $\frac{n}{2} + 2$

(C) There is a planar embedding in which the number of faces is less than $\frac{n}{2} + 2$

(D) There is a planar embedding in which the number of faces is at most $\frac{n}{\delta+1}$

Q.53 The CORRECT formula for the sentence, “not all rainy days are cold” is

- (A) $\forall d (\text{Rainy}(d) \wedge \sim \text{Cold}(d))$
- (B) $\forall d (\sim \text{Rainy}(d) \rightarrow \text{Cold}(d))$
- (C) $\exists d (\sim \text{Rainy}(d) \rightarrow \text{Cold}(d))$
- (D) $\exists d (\text{Rainy}(d) \wedge \sim \text{Cold}(d))$

Q.54 Consider the following relational schema:

employee(empId, empName, empDept)
customer(custId, custName, salesRepId, rating)

salesRepId is a foreign key referring to **empId** of the employee relation. Assume that each employee makes a sale to at least one customer. What does the following query return?

```
SELECT empName
FROM employee E
WHERE NOT EXISTS (SELECT custId
                  FROM customer C
                  WHERE C.salesRepId = E.empId
                  AND C.rating <> 'GOOD');
```

- (A) Names of all the employees with at least one of their customers having a ‘GOOD’ rating.
- (B) Names of all the employees with at most one of their customers having a ‘GOOD’ rating.
- (C) Names of all the employees with none of their customers having a ‘GOOD’ rating.
- (D) Names of all the employees with all their customers having a ‘GOOD’ rating.

Q.55 Let \oplus denote the Exclusive OR (XOR) operation. Let ‘1’ and ‘0’ denote the binary constants. Consider the following Boolean expression for F over two variables P and Q :

$$F(P, Q) = ((1 \oplus P) \oplus (P \oplus Q)) \oplus ((P \oplus Q) \oplus (Q \oplus 0))$$

The equivalent expression for F is

- (A) $P + Q$
- (B) $\overline{P + Q}$
- (C) $P \oplus Q$
- (D) $\overline{P \oplus Q}$

END OF THE QUESTION PAPER

GATE 2014

Answer Keys for CS - Computer Science and Information Technology

Section	Q. No.	SESSION - 9	
		Key / Range	Marks
GA	1	D	1
GA	2	C	1
GA	3	C	1
GA	4	C	1
GA	5	C	1
GA	6	B	2
GA	7	D	2
GA	8	D	2
GA	9	C	2
GA	10	C	2
CS	1	D	1
CS	2	D	1
CS	3	5 to 5	1
CS	4	A	1
CS	5	2 to 2	1
CS	6	4 to 4	1
CS	7	B	1
CS	8	C	1
CS	9	C	1
CS	10	A	1
CS	11	7 to 7	1
CS	12	A	1
CS	13	19 to 19	1
CS	14	A	1
CS	15	3 to 3	1
CS	16	C	1
CS	17	C	1
CS	18	D	1
CS	19	B	1
CS	20	6 to 6	1
CS	21	A	1
CS	22	B	1
CS	23	B	1

Section	Q. No.	SESSION - 9	
		Key / Range	Marks
CS	24	B	1
CS	25	D	1
CS	26	1 to 1	2
CS	27	256 to 256	2
CS	28	A	2
CS	29	A	2
CS	30	D	2
CS	31	7 to 7	2
CS	32	5.5 to 5.5	2
CS	33	122 to 122	2
CS	34	A	2
CS	35	A	2
CS	36	C	2
CS	37	150 to 150	2
CS	38	B	2
CS	39	110 to 110	2
CS	40	A	2
CS	41	D	2
CS	42	B	2
CS	43	1.50 to 1.60	2
CS	44	1.68 to 1.68	2
CS	45	C	2
CS	46	C	2
CS	47	A	2
CS	48	0.25 to 0.25	2
CS	49	B	2
CS	50	4 to 4	2
CS	51	C	2
CS	52	A	2
CS	53	D	2
CS	54	D	2
CS	55	D	2

GATE
Computer Science and
Information Technology
Engineering
Question Paper
2013
(with Solutions)

CS : COMPUTER SCIENCE AND INFORMATION TECHNOLOGY

Duration: Three Hours

Maximum Marks: 100

Read the following instructions carefully.

1. Do not open the seal of the Question Booklet until you are asked to do so by the invigilator.
2. Take out the **Optical Response Sheet (ORS)** from this Question Booklet **without breaking the seal** and read the instructions printed on the ORS carefully. If you find that either
 - a. The Question Booklet Code printed at the right hand top corner of this page does not match with the Question Booklet Code at the right hand top corner of the **ORS** or
 - b. The Question Paper Code preceding the Registration number on the **ORS** is not **CS**, then exchange the booklet immediately with a new sealed Question Booklet.
3. On the right hand side of the **ORS**, using **ONLY a black ink ballpoint pen**, (i) darken the appropriate bubble under each digit of your registration number and (ii) write your registration number, your name and name of the examination centre and put your signature at the specified location.
4. This Question Booklet contains **20** pages including blank pages for rough work. After you are permitted to open the seal, check all pages and report discrepancies, if any, to the invigilator.
5. There are a total of 65 questions carrying 100 marks. All these questions are of objective type. Each question has only **one** correct answer. Questions must be answered on the left hand side of the **ORS** by darkening the appropriate bubble (marked A, B, C, D) using **ONLY a black ink ballpoint pen** against the question number. **For each question darken the bubble of the correct answer.** More than one answer bubbled against a question will be treated as an incorrect response.
6. Since bubbles darkened by the black ink ballpoint pen **cannot** be erased, candidates should darken the bubbles in the ORS **very carefully**.
7. Questions Q.1 – Q.25 carry 1 mark each. Questions Q.26 – Q.55 carry 2 marks each. The 2 marks questions include two pairs of common data questions and two pairs of linked answer questions. The answer to the second question of the linked answer questions depends on the answer to the first question of the pair. If the first question in the linked pair is wrongly answered or is not attempted, then the answer to the second question in the pair will not be evaluated.
8. Questions Q.56 – Q.65 belong to General Aptitude (GA) section and carry a total of 15 marks. Questions Q.56 – Q.60 carry 1 mark each, and questions Q.61 – Q.65 carry 2 marks each.
9. Questions not attempted will result in zero mark and wrong answers will result in **NEGATIVE** marks. For all 1 mark questions, $\frac{1}{3}$ mark will be deducted for each wrong answer. For all 2 marks questions, $\frac{2}{3}$ mark will be deducted for each wrong answer. However, in the case of the linked answer question pair, there will be negative marks only for wrong answer to the first question and no negative marks for wrong answer to the second question.
10. Calculator is allowed whereas charts, graph sheets or tables are **NOT** allowed in the examination hall.
11. Rough work can be done on the Question Booklet itself. Blank pages are provided at the end of the Question Booklet for rough work.
12. Before the start of the examination, write your name and registration number in the space provided below using a black ink ballpoint pen.

Name										
Registration Number	CS									

Q.1 to Q.25 carry one mark each.

Q.1 A binary operation \oplus on a set of integers is defined as $x \oplus y = x^2 + y^2$. Which one of the following statements is **TRUE** about \oplus ?

- (A) Commutative but not associative (B) Both commutative and associative
(C) Associative but not commutative (D) Neither commutative nor associative

Q.2 Suppose p is the number of cars per minute passing through a certain road junction between 5 PM and 6 PM, and p has a Poisson distribution with mean 3. What is the probability of observing fewer than 3 cars during any given minute in this interval?

- (A) $8/(2e^3)$ (B) $9/(2e^3)$ (C) $17/(2e^3)$ (D) $26/(2e^3)$

Q.3 Which one of the following does **NOT** equal $\begin{vmatrix} 1 & x & x^2 \\ 1 & y & y^2 \\ 1 & z & z^2 \end{vmatrix}$?

(A) $\begin{vmatrix} 1 & x(x+1) & x+1 \\ 1 & y(y+1) & y+1 \\ 1 & z(z+1) & z+1 \end{vmatrix}$

(B) $\begin{vmatrix} 1 & x+1 & x^2+1 \\ 1 & y+1 & y^2+1 \\ 1 & z+1 & z^2+1 \end{vmatrix}$

(C) $\begin{vmatrix} 0 & x-y & x^2-y^2 \\ 0 & y-z & y^2-z^2 \\ 1 & z & z^2 \end{vmatrix}$

(D) $\begin{vmatrix} 2 & x+y & x^2+y^2 \\ 2 & y+z & y^2+z^2 \\ 1 & z & z^2 \end{vmatrix}$

Q.4 The smallest integer that can be represented by an 8-bit number in 2's complement form is

- (A) -256 (B) -128 (C) -127 (D) 0

Q.5 In the following truth table, $V = 1$ if and only if the input is valid.

Inputs				Outputs		
D_0	D_1	D_2	D_3	X_0	X_1	V
0	0	0	0	x	x	0
1	0	0	0	0	0	1
x	1	0	0	0	1	1
x	x	1	0	1	0	1
x	x	x	1	1	1	1

What function does the truth table represent?

- (A) Priority encoder (B) Decoder
(C) Multiplexer (D) Demultiplexer

Q.6 Which one of the following is the tightest upper bound that represents the number of swaps required to sort n numbers using selection sort?

- (A) $O(\log n)$ (B) $O(n)$ (C) $O(n \log n)$ (D) $O(n^2)$

Q.7 Which one of the following is the tightest upper bound that represents the time complexity of inserting an object into a binary search tree of n nodes?

- (A) $O(1)$ (B) $O(\log n)$ (C) $O(n)$ (D) $O(n \log n)$

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- Q.8 Consider the languages $L_1 = \Phi$ and $L_2 = \{a\}$. Which one of the following represents $L_1 L_2^* \cup L_1^*$?
(A) $\{e\}$ (B) Φ (C) a^* (D) $\{e, a\}$
- Q.9 What is the maximum number of reduce moves that can be taken by a bottom-up parser for a grammar with no epsilon- and unit-production (i.e., of type $A \rightarrow e$ and $A \rightarrow a$) to parse a string with n tokens?
(A) $n/2$ (B) $n-1$ (C) $2n-1$ (D) 2^n
- Q.10 A scheduling algorithm assigns priority proportional to the waiting time of a process. Every process starts with priority zero (the lowest priority). The scheduler re-evaluates the process priorities every T time units and decides the next process to schedule. Which one of the following is **TRUE** if the processes have no I/O operations and all arrive at time zero?
(A) This algorithm is equivalent to the first-come-first-serve algorithm.
(B) This algorithm is equivalent to the round-robin algorithm.
(C) This algorithm is equivalent to the shortest-job-first algorithm.
(D) This algorithm is equivalent to the shortest-remaining-time-first algorithm.
- Q.11 Match the problem domains in **GROUP I** with the solution technologies in **GROUP II**.

GROUP I

- (P) Service oriented computing
- (Q) Heterogeneous communicating systems
- (R) Information representation
- (S) Process description

GROUP II

- (1) Interoperability
- (2) BPMN
- (3) Publish-find-bind
- (4) XML

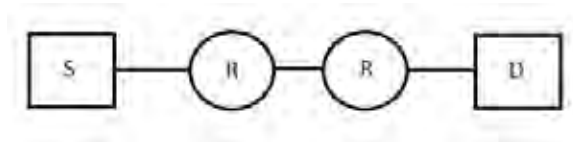
- (A) P-1, Q-2, R-3, S-4
- (B) P-3, Q-4, R-2, S-1
- (C) P-3, Q-1, R-4, S-2
- (D) P-4, Q-3, R-2, S-1

- Q.12 The transport layer protocols used for real time multimedia, file transfer, DNS and email, respectively are
(A) TCP, UDP, UDP and TCP
(B) UDP, TCP, TCP and UDP
(C) UDP, TCP, UDP and TCP
(D) TCP, UDP, TCP and UDP
- Q.13 Using public key cryptography, X adds a digital signature σ to message M, encrypts $\langle M, \sigma \rangle$, and sends it to Y, where it is decrypted. Which one of the following sequences of keys is used for the operations?
(A) Encryption: X's private key followed by Y's private key; Decryption: X's public key followed by Y's public key
(B) Encryption: X's private key followed by Y's public key; Decryption: X's public key followed by Y's private key
(C) Encryption: X's public key followed by Y's private key; Decryption: Y's public key followed by X's private key
(D) Encryption: X's private key followed by Y's public key; Decryption: Y's private key followed by X's public key

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- Q.14 Assume that source S and destination D are connected through two intermediate routers labeled R. Determine how many times each packet has to visit the network layer and the data link layer during a transmission from S to D.



- (A) Network layer – 4 times and Data link layer – 4 times
(B) Network layer – 4 times and Data link layer – 3 times
(C) Network layer – 4 times and Data link layer – 6 times
(D) Network layer – 2 times and Data link layer – 6 times
- Q.15 An index is clustered, if
- (A) it is on a set of fields that form a candidate key.
(B) it is on a set of fields that include the primary key.
(C) the data records of the file are organized in the same order as the data entries of the index.
(D) the data records of the file are organized not in the same order as the data entries of the index.
- Q.16 Three concurrent processes X, Y, and Z execute three different code segments that access and update certain shared variables. Process X executes the P operation (i.e., *wait*) on semaphores a, b and c; process Y executes the P operation on semaphores b, c and d; process Z executes the P operation on semaphores c, d, and a before entering the respective code segments. After completing the execution of its code segment, each process invokes the V operation (i.e., *signal*) on its three semaphores. All semaphores are binary semaphores initialized to one. Which one of the following represents a deadlock-free order of invoking the P operations by the processes?
- (A) X: P(a)P(b)P(c) Y: P(b)P(c)P(d) Z: P(c)P(d)P(a)
(B) X: P(b)P(a)P(c) Y: P(b)P(c)P(d) Z: P(a)P(c)P(d)
(C) X: P(b)P(a)P(c) Y: P(c)P(b)P(d) Z: P(a)P(c)P(d)
(D) X: P(a)P(b)P(c) Y: P(c)P(b)P(d) Z: P(c)P(d)P(a)
- Q.17 Which of the following statements is/are **FALSE**?
1. For every non-deterministic Turing machine, there exists an equivalent deterministic Turing machine.
 2. Turing recognizable languages are closed under union and complementation.
 3. Turing decidable languages are closed under intersection and complementation.
 4. Turing recognizable languages are closed under union and intersection.
- (A) 1 and 4 only (B) 1 and 3 only (C) 2 only (D) 3 only
- Q.18 Which of the following statements are **TRUE**?
1. The problem of determining whether there exists a cycle in an undirected graph is in P.
 2. The problem of determining whether there exists a cycle in an undirected graph is in NP.
 3. If a problem A is NP-Complete, there exists a non-deterministic polynomial time algorithm to solve A.
- (A) 1, 2 and 3 (B) 1 and 2 only (C) 2 and 3 only (D) 1 and 3 only

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Q.19 What is the time complexity of Bellman-Ford single-source shortest path algorithm on a complete graph of n vertices?

- (A) $\Theta(n^2)$ (B) $\Theta(n^2 \log n)$ (C) $\Theta(n^3)$ (D) $\Theta(n^3 \log n)$

Q.20 In a k -way set associative cache, the cache is divided into v sets, each of which consists of k lines. The lines of a set are placed in sequence one after another. The lines in set s are sequenced before the lines in set $(s+1)$. The main memory blocks are numbered 0 onwards. The main memory block numbered j must be mapped to any one of the cache lines from

- (A) $(j \bmod v) * k$ to $(j \bmod v) * k + (k-1)$ (B) $(j \bmod v)$ to $(j \bmod v) + (k-1)$
(C) $(j \bmod k)$ to $(j \bmod k) + (v-1)$ (D) $(j \bmod k) * v$ to $(j \bmod k) * v + (v-1)$

Q.21 Which one of the following expressions does **NOT** represent exclusive NOR of x and y ?

- (A) $xy + x'y'$ (B) $x \oplus y'$ (C) $x' \oplus y$ (D) $x' \oplus y'$

Q.22 Which one of the following functions is continuous at $x = 3$?

- (A) $f(x) = \begin{cases} 2, & \text{if } x = 3 \\ x-1, & \text{if } x > 3 \\ \frac{x+3}{3}, & \text{if } x < 3 \end{cases}$ (B) $f(x) = \begin{cases} 4, & \text{if } x = 3 \\ 8-x, & \text{if } x \neq 3 \end{cases}$
(C) $f(x) = \begin{cases} x+3, & \text{if } x \leq 3 \\ x-4, & \text{if } x > 3 \end{cases}$ (D) $f(x) = \frac{1}{x^3 - 27}, \text{ if } x \neq 3$

Q.23 Function f is known at the following points:

x	0	0.3	0.6	0.9	1.2	1.5	1.8	2.1	2.4	2.7	3.0
$f(x)$	0	0.09	0.36	0.81	1.44	2.25	3.24	4.41	5.76	7.29	9.00

The value of $\int_0^3 f(x) dx$ computed using the trapezoidal rule is

- (A) 8.983 (B) 9.003 (C) 9.017 (D) 9.045

Q.24 Consider an undirected random graph of eight vertices. The probability that there is an edge between a pair of vertices is $1/2$. What is the expected number of unordered cycles of length three?

- (A) $1/8$ (B) 1 (C) 7 (D) 8

Q.25 Which of the following statements is/are **TRUE** for undirected graphs?

P: Number of odd degree vertices is even.

Q: Sum of degrees of all vertices is even.

- (A) P only (B) Q only (C) Both P and Q (D) Neither P nor Q

Q.26 to Q.55 carry two marks each.

Q.26 The line graph $L(G)$ of a simple graph G is defined as follows:

- There is exactly one vertex $v(e)$ in $L(G)$ for each edge e in G .
- For any two edges e and e' in G , $L(G)$ has an edge between $v(e)$ and $v(e')$, if and only if e and e' are incident with the same vertex in G .

Which of the following statements is/are **TRUE**?

- (P) The line graph of a cycle is a cycle.
 - (Q) The line graph of a clique is a clique.
 - (R) The line graph of a planar graph is planar.
 - (S) The line graph of a tree is a tree.
- (A) P only (B) P and R only
(C) R only (D) P, Q and S only

Q.27 What is the logical translation of the following statement?

“None of my friends are perfect.”

- (A) $\exists x(F(x) \wedge \neg P(x))$ (B) $\exists x(\neg F(x) \wedge P(x))$
(C) $\exists x(\neg F(x) \wedge \neg P(x))$ (D) $\neg \exists x(F(x) \wedge P(x))$

Q.28 Consider the following sequence of micro-operations.

MBR \leftarrow PC
MAR \leftarrow X
PC \leftarrow Y
Memory \leftarrow MBR

Which one of the following is a possible operation performed by this sequence?

- (A) Instruction fetch (B) Operand fetch
(C) Conditional branch (D) Initiation of interrupt service

Q.29 Consider a hard disk with 16 recording surfaces (0-15) having 16384 cylinders (0-16383) and each cylinder contains 64 sectors (0-63). Data storage capacity in each sector is 512 bytes. Data are organized cylinder-wise and the addressing format is <cylinder no., surface no., sector no.>. A file of size 42797 KB is stored in the disk and the starting disk location of the file is <1200, 9, 40>. What is the cylinder number of the last sector of the file, if it is stored in a contiguous manner?

- (A) 1281 (B) 1282 (C) 1283 (D) 1284

Q.30 The number of elements that can be sorted in $\Theta(\log n)$ time using heap sort is

- (A) $\Theta(1)$ (B) $\Theta(\sqrt{\log n})$ (C) $\Theta\left(\frac{\log n}{\log \log n}\right)$ (D) $\Theta(\log n)$

Q.31 Consider the following function:

```
int unknown(int n){
    int i, j, k=0;
    for (i=n/2; i<=n; i++)
        for (j=2; j<=n; j=j*2)
            k = k + n/2;
    return (k);
}
```

The return value of the function is

- (A) $\Theta(n^2)$ (B) $\Theta(n^2 \log n)$ (C) $\Theta(n^3)$ (D) $\Theta(n^3 \log n)$

Q.32 Consider the following languages.

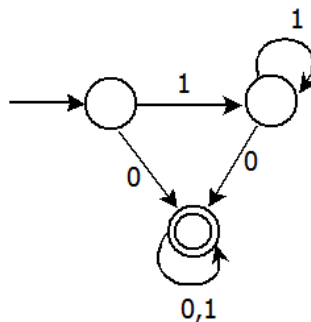
$$L_1 = \{0^p 1^q 0^r \mid p, q, r \geq 0\}$$

$$L_2 = \{0^p 1^q 0^r \mid p, q, r \geq 0, p \neq r\}$$

Which one of the following statements is **FALSE**?

- (A) L_2 is context-free.
 (B) $L_1 \cap L_2$ is context-free.
 (C) Complement of L_2 is recursive.
 (D) Complement of L_1 is context-free but not regular.

Q.33 Consider the DFA A given below.



Which of the following are **FALSE**?

1. Complement of $L(A)$ is context-free.
2. $L(A) = L((11^*0+0)(0+1)^*0^*1^*)$
3. For the language accepted by A, A is the minimal DFA.
4. A accepts all strings over $\{0, 1\}$ of length at least 2.

- (A) 1 and 3 only (B) 2 and 4 only (C) 2 and 3 only (D) 3 and 4 only

Q.34 A shared variable x , initialized to zero, is operated on by four concurrent processes W, X, Y, Z as follows. Each of the processes W and X reads x from memory, increments by one, stores it to memory, and then terminates. Each of the processes Y and Z reads x from memory, decrements by two, stores it to memory, and then terminates. Each process before reading x invokes the P operation (i.e., *wait*) on a counting semaphore S and invokes the V operation (i.e., *signal*) on the semaphore S after storing x to memory. Semaphore S is initialized to two. What is the maximum possible value of x after all processes complete execution?

- (A) -2 (B) -1 (C) 1 (D) 2

Q.35 Consider the following relational schema.

Students(rollno: integer, sname: string)

Courses(courseno: integer, cname: string)

Registration(rollno: integer, courseno: integer, percent: real)

Which of the following queries are equivalent to this query in English?

“Find the distinct names of all students who score more than 90% in the course numbered 107”

(I) SELECT DISTINCT S.sname

FROM Students as S, Registration as R

WHERE R.rollno=S.rollno AND R.courseno=107 AND R.percent >90

(II) $\Pi_{\text{sname}}(\sigma_{\text{courseno}=107 \wedge \text{percent}>90}(\text{Registration} \bowtie \text{Students}))$

(III) $\{T \mid \exists S \in \text{Students}, \exists R \in \text{Registration} (S.\text{rollno}=R.\text{rollno} \wedge$

$R.\text{courseno}=107 \wedge R.\text{percent}>90 \wedge T.\text{sname}=S.\text{sname})\}$

(IV) $\{ \langle S_N \rangle \mid \exists S_R \exists R_P (\langle S_R, S_N \rangle \in \text{Students} \wedge \langle S_R, 107, R_P \rangle \in \text{Registration} \wedge R_P > 90) \}$

(A) I, II, III and IV

(B) I, II and III only

(C) I, II and IV only

(D) II, III and IV only

Q.36 Determine the maximum length of the cable (in km) for transmitting data at a rate of 500 Mbps in an Ethernet LAN with frames of size 10,000 bits. Assume the signal speed in the cable to be 2,00,000 km/s.

(A) 1

(B) 2

(C) 2.5

(D) 5

Q.37 In an IPv4 datagram, the M bit is 0, the value of HLEN is 10, the value of total length is 400 and the fragment offset value is 300. The position of the datagram, the sequence numbers of the first and the last bytes of the payload, respectively are

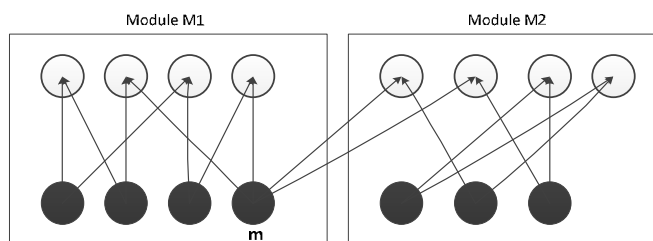
(A) Last fragment, 2400 and 2789

(B) First fragment, 2400 and 2759

(C) Last fragment, 2400 and 2759

(D) Middle fragment, 300 and 689

Q.38 The following figure represents access graphs of two modules M1 and M2. The filled circles represent methods and the unfilled circles represent attributes. If method m is moved to module M2 keeping the attributes where they are, what can we say about the average cohesion and coupling between modules in the system of two modules?



(A) There is no change.

(B) Average cohesion goes up but coupling is reduced.

(C) Average cohesion goes down and coupling also reduces.

(D) Average cohesion and coupling increase.

- Q.39 A certain computation generates two arrays a and b such that $a[i]=f(i)$ for $0 \leq i < n$ and $b[i] = g(a[i])$ for $0 \leq i < n$. Suppose this computation is decomposed into two concurrent processes X and Y such that X computes the array a and Y computes the array b . The processes employ two binary semaphores R and S , both initialized to zero. The array a is shared by the two processes. The structures of the processes are shown below.

<pre> Process X: private i; for (i=0; i<n; i++) { a[i] = f(i); ExitX(R, S); } </pre>	<pre> Process Y: private i; for (i=0; i<n; i++) { EntryY(R, S); b[i] = g(a[i]); } </pre>
---------------------------------------------------------------------------------------------------------	-------------------------------------------------------------------------------------------------------------

Which one of the following represents the **CORRECT** implementations of ExitX and EntryY ?

- | | |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>(A) $\text{ExitX}(R, S) \{$
 $\quad P(R);$
 $\quad V(S);$
 $\}$
 $\text{EntryY}(R, S) \{$
 $\quad P(S);$
 $\quad V(R);$
 $\}$</p> | <p>(B) $\text{ExitX}(R, S) \{$
 $\quad V(R);$
 $\quad V(S);$
 $\}$
 $\text{EntryY}(R, S) \{$
 $\quad P(R);$
 $\quad P(S);$
 $\}$</p> |
| <p>(C) $\text{ExitX}(R, S) \{$
 $\quad P(S);$
 $\quad V(R);$
 $\}$
 $\text{EntryY}(R, S) \{$
 $\quad V(S);$
 $\quad P(R);$
 $\}$</p> | <p>(D) $\text{ExitX}(R, S) \{$
 $\quad V(R);$
 $\quad P(S);$
 $\}$
 $\text{EntryY}(R, S) \{$
 $\quad V(S);$
 $\quad P(R);$
 $\}$</p> |

- Q.40 Consider the following two sets of LR(1) items of an LR(1) grammar.

$X \rightarrow c.X, c/d$	$X \rightarrow c.X, \$$
$X \rightarrow .cX, c/d$	$X \rightarrow .cX, \$$
$X \rightarrow .d, c/d$	$X \rightarrow .d, \$$

Which of the following statements related to merging of the two sets in the corresponding LALR parser is/are **FALSE**?

1. Cannot be merged since look aheads are different.
2. Can be merged but will result in S-R conflict.
3. Can be merged but will result in R-R conflict.
4. Cannot be merged since *goto* on c will lead to two different sets.

- (A) 1 only (B) 2 only (C) 1 and 4 only (D) 1, 2, 3 and 4

- Q.41 Which of the following is/are undecidable?

1. G is a CFG. Is $L(G) = \Phi$?
2. G is a CFG. Is $L(G) = \Sigma^*$?
3. M is a Turing machine. Is $L(M)$ regular?
4. A is a DFA and N is an NFA. Is $L(A) = L(N)$?

- (A) 3 only (B) 3 and 4 only (C) 1, 2 and 3 only (D) 2 and 3 only

- Q.42 What is the return value of $f(p, p)$, if the value of p is initialized to 5 before the call? Note that the first parameter is passed by reference, whereas the second parameter is passed by value.

```
int f (int &x, int c) {  
    c = c - 1;  
    if (c==0) return 1;  
    x = x + 1;  
    return f(x,c) * x;  
}
```

- (A) 3024 (B) 6561 (C) 55440 (D) 161051

- Q.43 The preorder traversal sequence of a binary search tree is 30, 20, 10, 15, 25, 23, 39, 35, 42. Which one of the following is the postorder traversal sequence of the same tree?

- (A) 10, 20, 15, 23, 25, 35, 42, 39, 30 (B) 15, 10, 25, 23, 20, 42, 35, 39, 30
(C) 15, 20, 10, 23, 25, 42, 35, 39, 30 (D) 15, 10, 23, 25, 20, 35, 42, 39, 30

- Q.44 Consider the following operation along with Enqueue and Dequeue operations on queues, where k is a global parameter.

```
MultiDequeue(Q) {  
    m = k  
    while (Q is not empty) and (m > 0) {  
        Dequeue(Q)  
        m = m - 1  
    }  
}
```

What is the worst case time complexity of a sequence of n queue operations on an initially empty queue?

- (A) $\Theta(n)$ (B) $\Theta(n + k)$ (C) $\Theta(nk)$ (D) $\Theta(n^2)$

- Q.45 Consider an instruction pipeline with five stages without any branch prediction: Fetch Instruction (FI), Decode Instruction (DI), Fetch Operand (FO), Execute Instruction (EI) and Write Operand (WO). The stage delays for FI, DI, FO, EI and WO are 5 ns, 7 ns, 10 ns, 8 ns and 6 ns, respectively. There are intermediate storage buffers after each stage and the delay of each buffer is 1 ns. A program consisting of 12 instructions $I_1, I_2, I_3, \dots, I_{12}$ is executed in this pipelined processor. Instruction I_4 is the only branch instruction and its branch target is I_9 . If the branch is taken during the execution of this program, the time (in ns) needed to complete the program is

- (A) 132 (B) 165 (C) 176 (D) 328

- Q.46 A RAM chip has a capacity of 1024 words of 8 bits each ($1K \times 8$). The number of 2×4 decoders with enable line needed to construct a $16K \times 16$ RAM from $1K \times 8$ RAM is

- (A) 4 (B) 5 (C) 6 (D) 7

- Q.47 Which one of the following is **NOT** logically equivalent to $\neg \exists x (\forall y (\alpha) \wedge \forall z (\beta))$?

- (A) $\forall x (\exists z (\neg \beta) \rightarrow \forall y (\alpha))$ (B) $\forall x (\forall z (\beta) \rightarrow \exists y (\neg \alpha))$
(C) $\forall x (\forall y (\alpha) \rightarrow \exists z (\neg \beta))$ (D) $\forall x (\exists y (\neg \alpha) \rightarrow \exists z (\neg \beta))$

Common Data Questions**Common Data for Questions 48 and 49:**

The following code segment is executed on a processor which allows only register operands in its instructions. Each instruction can have at most two source operands and one destination operand. Assume that all variables are dead after this code segment.

```
c = a + b;
d = c * a;
e = c + a;
x = c * c;
if (x > a) {
    y = a * a;
}
else {
    d = d * d;
    e = e * e;
}
```

Q.48 Suppose the instruction set architecture of the processor has only two registers. The only allowed compiler optimization is code motion, which moves statements from one place to another while preserving correctness. What is the minimum number of spills to memory in the compiled code?

- (A) 0 (B) 1 (C) 2 (D) 3

Q.49 What is the minimum number of registers needed in the instruction set architecture of the processor to compile this code segment without any spill to memory? Do not apply any optimization other than optimizing register allocation.

- (A) 3 (B) 4 (C) 5 (D) 6

Common Data for Questions 50 and 51:

The procedure given below is required to find and replace certain characters inside an input character string supplied in array A. The characters to be replaced are supplied in array oldc, while their respective replacement characters are supplied in array newc. Array A has a fixed length of five characters, while arrays oldc and newc contain three characters each. However, the procedure is flawed.

```
void find_and_replace (char *A, char *oldc, char *newc) {
    for (int i=0; i<5; i++)
        for (int j=0; j<3; j++)
            if (A[i] == oldc[j]) A[i] = newc[j];
}
```

The procedure is tested with the following four test cases.

- (1) oldc = "abc", newc = "dab" (2) oldc = "cde", newc = "bcd"
(3) oldc = "bca", newc = "cda" (4) oldc = "abc", newc = "bac"

Q.50 The tester now tests the program on all input strings of length five consisting of characters 'a', 'b', 'c', 'd' and 'e' with duplicates allowed. If the tester carries out this testing with the four test cases given above, how many test cases will be able to capture the flaw?

- (A) Only one (B) Only two (C) Only three (D) All four

Q.51 If array A is made to hold the string "abcde", which of the above four test cases will be successful in exposing the flaw in this procedure?

- (A) None (B) 2 only
(C) 3 and 4 only (D) 4 only

Linked Answer Questions**Statement for Linked Answer Questions 52 and 53:**

A computer uses 46-bit virtual address, 32-bit physical address, and a three-level paged page table organization. The page table base register stores the base address of the first-level table (T_1), which occupies exactly one page. Each entry of T_1 stores the base address of a page of the second-level table (T_2). Each entry of T_2 stores the base address of a page of the third-level table (T_3). Each entry of T_3 stores a page table entry (PTE). The PTE is 32 bits in size. The processor used in the computer has a 1 MB 16-way set associative virtually indexed physically tagged cache. The cache block size is 64 bytes.

Q.52 What is the size of a page in KB in this computer?

- (A) 2 (B) 4 (C) 8 (D) 16

Q.53 What is the minimum number of page colours needed to guarantee that no two synonyms map to different sets in the processor cache of this computer?

- (A) 2 (B) 4 (C) 8 (D) 16

Statement for Linked Answer Questions 54 and 55:

Relation R has eight attributes $ABCDEFGH$. Fields of R contain only atomic values.

$F = \{CH \rightarrow G, A \rightarrow BC, B \rightarrow CFH, E \rightarrow A, F \rightarrow EG\}$ is a set of functional dependencies (FDs) so that F^+ is exactly the set of FDs that hold for R .

Q.54 How many candidate keys does the relation R have?

- (A) 3 (B) 4 (C) 5 (D) 6

Q.55 The relation R is

- (A) in 1NF, but not in 2NF. (B) in 2NF, but not in 3NF.
(C) in 3NF, but not in BCNF. (D) in BCNF.

General Aptitude (GA) Questions

Q.56 to Q.60 carry one mark each.

Q.56 Which one of the following options is the closest in meaning to the word given below?

Nadir

- (A) Highest (B) Lowest (C) Medium (D) Integration

Q.57 Complete the sentence:

Universalism is to particularism as diffuseness is to _____.

- (A) specificity (B) neutrality (C) generality (D) adaptation

Q.58 What will be the maximum sum of 44, 42, 40, ?

- (A) 502 (B) 504 (C) 506 (D) 500

Q.59 Were you a bird, you _____ in the sky.

- (A) would fly (B) shall fly (C) should fly (D) shall have flown

Q.60 Choose the grammatically **INCORRECT** sentence:

- (A) He is of Asian origin.
(B) They belonged to Africa.
(C) She is an European.
(D) They migrated from India to Australia.

Q.61 to Q.65 carry two marks each.

Q.61 Find the sum of the expression

$$\frac{1}{\sqrt{1} + \sqrt{2}} + \frac{1}{\sqrt{2} + \sqrt{3}} + \frac{1}{\sqrt{3} + \sqrt{4}} + \dots + \frac{1}{\sqrt{80} + \sqrt{81}}$$

- (A) 7 (B) 8
(C) 9 (D) 10

Q.62 Out of all the 2-digit integers between 1 and 100, a 2-digit number has to be selected at random. What is the probability that the selected number is not divisible by 7?

- (A) 13/90 (B) 12/90 (C) 78/90 (D) 77/90

- Q.63 After several defeats in wars, Robert Bruce went in exile and wanted to commit suicide. Just before committing suicide, he came across a spider attempting tirelessly to have its net. Time and again, the spider failed but that did not deter it to refrain from making attempts. Such attempts by the spider made Bruce curious. Thus, Bruce started observing the near-impossible goal of the spider to have the net. Ultimately, the spider succeeded in having its net despite several failures. Such act of the spider encouraged Bruce not to commit suicide. And then, Bruce went back again and won many a battle, and the rest is history.

Which one of the following assertions is best supported by the above information?

- (A) Failure is the pillar of success.
(B) Honesty is the best policy.
(C) Life begins and ends with adventures.
(D) No adversity justifies giving up hope.
- Q.64 A tourist covers half of his journey by train at 60 km/h, half of the remainder by bus at 30 km/h and the rest by cycle at 10 km/h. The average speed of the tourist in km/h during his entire journey is
- (A) 36 (B) 30 (C) 24 (D) 18
- Q.65 The current erection cost of a structure is Rs. 13,200. If the labour wages per day increase by $\frac{1}{5}$ of the current wages and the working hours decrease by $\frac{1}{24}$ of the current period, then the new cost of erection in Rs. is
- (A) 16,500 (B) 15,180 (C) 11,000 (D) 10,120

END OF THE QUESTION PAPER

Space for Rough Work

Space for Rough Work

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GATE 2013 : Answer keys for CS - Computer Science and Information Technology

Paper	Q.No	ORS code A	ORS code B	ORS Code C	ORS Code D
		Key(s)/Value(s)	Key(s)/Value(s)	Key(s)/Value(s)	Key(s)/Value(s)
CS	1	A	C	D	C
CS	2	C	C	C	C
CS	3	A	D	B	C
CS	4	B	A	B	B
CS	5	A	D	A	C
CS	6	B	A	C	A
CS	7	C	C	B	C
CS	8	A	A	A	A
CS	9	B	C	B	D
CS	10	B	B	A	A
CS	11	C	C	C	D
CS	12	C	C	A	C
CS	13	D	C	C	C
CS	14	C	D	C	A
CS	15	C	C	D	C
CS	16	B	B	A	A
CS	17	C	B	D	B
CS	18	A	A	A	A
CS	19	C	C	C	B
CS	20	A	B	A	C
CS	21	D	A	C	A
CS	22	A	B	B	B
CS	23	D	A	C	B
CS	24	C	C	C	C
CS	25	C	A	C	D
CS	26	A	Marks to All	B	C
CS	27	D	B	A	A
CS	28	D	B	D	C
CS	29	D	A	D	D
CS	30	C	D	D	D
CS	31	B	Marks to All	B	Marks to All
CS	32	D	D	C	D
CS	33	D	D	D	B
CS	34	D	C	D	A
CS	35	A	A	A	B

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Paper	Q.No	ORS code A	ORS code B	ORS Code C	ORS Code D
		Key(s)/Value(s)	Key(s)/Value(s)	Key(s)/Value(s)	Key(s)/Value(s)
CS	36	B	C	D	Marks to All
CS	37	C	B	Marks to All	D
CS	38	A	A	B	A
CS	39	C	D	B	D
CS	40	D	D	A	D
CS	41	D	D	D	C
CS	42	Marks to All	B	Marks to All	B
CS	43	D	C	D	D
CS	44	A	D	D	D
CS	45	B	D	C	D
CS	46	B	A	C	A
CS	47	Marks to All	D	A	B
CS	48	B	B	B	C
CS	49	B	C	B	B
CS	50	B	B	C	B
CS	51	C	B	B	B
CS	52	C	B	C	B
CS	53	C	A	C	A
CS	54	B	C	B	C
CS	55	A	C	A	C
CS	56	B	A	A	C
CS	57	A	A	C	C
CS	58	C	B	A	A
CS	59	A	C	C	B
CS	60	C	C	B	A
CS	61	B	D	C	B
CS	62	D	C	B	D
CS	63	D	B	D	C
CS	64	C	B	D	B
CS	65	B	D	B	D