# 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 of⅓ marks for a 1-mark question and ⅔ 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".

Q. 1 – Q. 5 carry one mark each.

Q.1   Choose the most appropriate phrase from the options given below to complete the following sentence.

India is a post-colonial country because

(A) it was a former British colony
(B) Indian Information Technology professionals have colonized the world
(C) India does not follow any colonial practices
(D) India has helped other countries gain freedom

Q.2   Who _____ was coming to see us this evening?

(A) you said   (B) did you say
(C) did you say that   (D) had you said

Q.3   Match the columns.

Column 1	Column 2
1) eradicate	P) misrepresent
2) distort	Q) soak completely
3) saturate	R) use
4) utilize	S) destroy utterly

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

Q.4   What is the average of all multiples of 10 from 2 to 198?

(A) 90   (B) 100   (C) 110   (D) 120

Q.5   The value of $\sqrt{12 + \sqrt{12 + \sqrt{12 + \cdots}}}$ is

(A) 3.464   (B) 3.932   (C) 4.000   (D) 4.444

Q. 6 – Q. 10 carry two marks each.

Q.6   The old city of Koenigsberg, which had a German majority population before World War 2, is now called Kaliningrad. After the events of the war, Kaliningrad is now a Russian territory and has a predominantly Russian population. It is bordered by the Baltic Sea on the north and the countries of Poland to the south and west and Lithuania to the east respectively. Which of the statements below can be inferred from this passage?

(A) Kaliningrad was historically Russian in its ethnic make up
(B) Kaliningrad is a part of Russia despite it not being contiguous with the rest of Russia
(C) Koenigsberg was renamed Kaliningrad, as that was its original Russian name
(D) Poland and Lithuania are on the route from Kaliningrad to the rest of Russia

Q.7   The number of people diagnosed with dengue fever (contracted from the bite of a mosquito) in north India is twice the number diagnosed last year. Municipal authorities have concluded that measures to control the mosquito population have failed in this region.

Which one of the following statements, if true, does not contradict this conclusion?

(A) A high proportion of the affected population has returned from neighbouring countries where dengue is prevalent

(B) More cases of dengue are now reported because of an increase in the Municipal Office's administrative efficiency

(C) Many more cases of dengue are being diagnosed this year since the introduction of a new and effective diagnostic test

(D) The number of people with malarial fever (also contracted from mosquito bites) has increased this year

Q.8   If x is real and $|x^2 - 2x + 3| = 11$, then possible values of $|-x^3 + x^2 - x|$ include

(A) 2, 4   (B) 2, 14   (C) 4, 52   (D) 14, 52

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 doubled in 2009, by what percent did the number of male students increase in 2009?

Q.10   At what time between 6 $a.m.$ and 7 $a.m.$ will the minute hand and hour hand of a clock make an angle closest to 60°?

(A) 6: 22 $a.m.$ (B) 6: 27 $a.m.$
(C) 6: 38 $a.m.$ (D) 6: 45 $a.m.$

END OF THE QUESTION PAPER

Q. 1 – Q. 25 carry one mark each.

Q.1　The security system at an IT office is composed of 10 computers of which exactly four are working. To check whether the system is functional, the officials inspect four of the computers picked at random (without replacement). The system is deemed functional if at least three of the four computers inspected are working. Let the probability that the system is deemed functional be denoted by p. Then $100p =$ _____.

Q.2　Each of the nine words in the sentence ″**The quick brown fox jumps over the lazy dog**″ is written on a separate piece of paper. These nine pieces of paper are kept in a box. One of the pieces is drawn at random from the box. The *expected* length of the word drawn is _____. (The answer should be rounded to one decimal place.)

Q.3　The maximum number of edges in a bipartite graph on 12 vertices is _____.

Q.4　If the matrix A is such that

$$A = \begin{bmatrix} 2 \\ -4 \\ 7 \end{bmatrix} \begin{bmatrix} 1 & 9 & 5 \end{bmatrix}$$

then the determinant of A is equal to _____.

Q.5　A non-zero polynomial $f(x)$ of degree 3 has roots at $x = 1, x = 2$ and $x = 3$. Which one of the following must be TRUE?

(A) $f(0)f(4) < 0$
(B) $f(0)f(4) > 0$
(C) $f(0) + f(4) > 0$
(D) $f(0) + f(4) < 0$

Q.6　The dual of a Boolean function $F(x_1, x_2, \ldots, x_n, +, \cdot, ')$, written as F^D, is the same expression as that of F with $+$ and $\cdot$ swapped. F is said to be self-dual if $F = F^D$. The number of self-dual functions with n Boolean variables is

(A) 2^n　　　　　(B) 2^{n-1}　　　　　(C) 2^{2^n}　　　　　(D) $2^{2^{n-1}}$

Q.7   Let $k = 2^n$. A circuit is built by giving the output of an n-bit binary counter as input to an n-to-2^n bit decoder. This circuit is equivalent to a

      (A) k-bit binary up counter.

      (B) k-bit binary down counter.

      (C) k-bit ring counter.

      (D) k-bit Johnson counter.

Q.8   Consider the equation $(123)_5 = (x8)_y$ with x and y as unknown. The number of possible solutions is _____ .

Q.9   A 4-way set-associative cache memory unit with a capacity of 16 KB is built using a block size of 8 words. The word length is 32 bits. The size of the physical address space is 4 GB. The number of bits for the TAG field is _____

Q.10   Consider the function func shown below:

```
int func(int num) {
int count = 0;
    while (num) {
        count++;
        num>>= 1;
    }
return (count);
}
```

      The value returned by func(435) is _____.

Q.11   Suppose n and p are unsigned int variables in a C program. We wish to set p to $^nC_3$. If n is large, which one of the following statements is most likely to set p correctly?

      (A)   p = n * (n-1) * (n-2) / 6;

      (B)   p = n * (n-1) / 2 * (n-2) / 3;

      (C)   p = n * (n-1) / 3 * (n-2) / 2;

      (D)   p = n * (n-1) * (n-2) / 6.0;

Q.12   A priority queue is implemented as a Max-Heap. Initially, it has 5 elements. The level-order traversal of the heap is: 10, 8, 5, 3, 2. Two new elements 1 and 7 are inserted into the heap in that order. The level-order traversal of the heap after the insertion of the elements is:

(A) 10, 8, 7, 3, 2, 1, 5   (B) 10, 8, 7, 2, 3, 1, 5

(C) 10, 8, 7, 1, 2, 3, 5   (D) 10, 8, 7, 5, 3, 2, 1

Q.13   Which one of the following correctly determines the solution of the recurrence relation with $T(1) = 1$?

$$T(n) = 2T\left(\frac{n}{2}\right) + \log n$$

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

Q.14   Consider the tree arcs of a BFS traversal from a source node **W** in an unweighted, connected, undirected graph. The tree **T** formed by the tree arcs is a data structure for computing

(A)   the shortest path between every pair of vertices.

(B)   the shortest path from **W** to every vertex in the graph.

(C)   the shortest paths from **W** to only those nodes that are leaves of **T**.

(D)   the longest path in the graph.

Q.15   If $L_1 = \{a^n | \ n \geq 0\}$ and $L_2 = \{b^n | \ n \geq 0\}$, consider

(I) $L_1 \cdot L_2$ is a regular language
(II) $L_1 \cdot L_2 = \{a^n b^n | n \geq 0\}$

Which one of the following is CORRECT?

(A) Only (I)   (B) Only (II)

(C) Both (I) and (II)   (D) Neither (I) nor (II)

Q.16   Let $A \leq_m B$ denotes that language A is mapping reducible (also known as many-to-one reducible) to language B. Which one of the following is FALSE?

(A) If $A \leq_m B$ and B is recursive then A is recursive.

(B) If $A \leq_m B$ and A is undecidable then B is undecidable.

(C) If $A \leq_m B$ and B is recursively enumerable then A is recursively enumerable.

(D) If $A \leq_m B$ and B is not recursively enumerable then A is not recursively enumerable.

Q.17   Consider the grammar defined by the following production rules, with two operators $*$ and $+$

$$S \rightarrow T * P$$
$$T \rightarrow U \mid T * U$$
$$P \rightarrow Q + P \mid Q$$
$$Q \rightarrow Id$$
$$U \rightarrow Id$$

Which one of the following is TRUE?

(A) $+$ is left associative, while $*$ is right associative

(B) $+$ is right associative, while $*$ is left associative

(C) Both $+$ and $*$ are right associative

(D) Both $+$ and $*$ are left associative

Q.18   Which one of the following is **NOT** performed during compilation?

(A)   Dynamic memory allocation   (B)   Type checking

(C)   Symbol table management   (D)   Inline expansion

Q.19   Which one of the following is TRUE?

(A) The requirements document also describes how the requirements that are listed in the document are implemented efficiently.

(B) Consistency and completeness of functional requirements are always achieved in practice.

(C) Prototyping is a method of requirements validation.

(D) Requirements review is carried out to find the errors in system design.

Q.20   A FAT (file allocation table) based file system is being used and the total overhead of each entry in the FAT is 4 bytes in size. Given a 100 x 10^6 bytes disk on which the file system is stored and data block size is 10^3 bytes, the maximum size of a file that can be stored on this disk in units of 10^6 bytes is _____.

Q.21   The maximum number of superkeys for the relation schema R(E,F,G,H) with E as the key is _____.

Q.22   Given an instance of the STUDENTS relation as shown below:

StudentID	StudentName	StudentEmail	StudentAge	CPI
2345	Shankar	shankar@math	X	9.4
1287	Swati	swati@ee	19	9.5
7853	Shankar	shankar@cse	19	9.4
9876	Swati	swati@mech	18	9.3
8765	Ganesh	ganesh@civil	19	8.7

For *(StudentName, StudentAge)* to be a key for this instance, the value X should NOT be equal to _____.


Q.23   Which one of the following is TRUE about the interior gateway routing protocols – Routing Information Protocol (RIP) and Open Shortest Path First (OSPF)?

(A) RIP uses distance vector routing and OSPF uses link state routing

(B) OSPF uses distance vector routing and RIP uses link state routing

(C) Both RIP and OSPF use link state routing

(D) Both RIP and OSPF use distance vector routing

Q.24   Which one of the following socket API functions converts an unconnected active TCP socket into a passive socket?
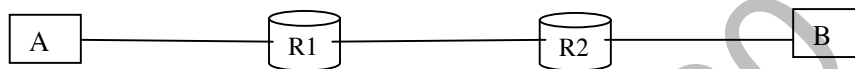
(A) connect

(B) bind

(C) listen

(D) accept

Q.25   In the diagram shown below, L1 is an Ethernet LAN and L2 is a Token-Ring LAN. An IP packet originates from sender S and traverses to R, as shown. The links within each ISP and across the two ISPs, are all point-to-point optical links. The initial value of the TTL field is 32. The maximum possible value of the TTL field when R receives the datagram is _____.
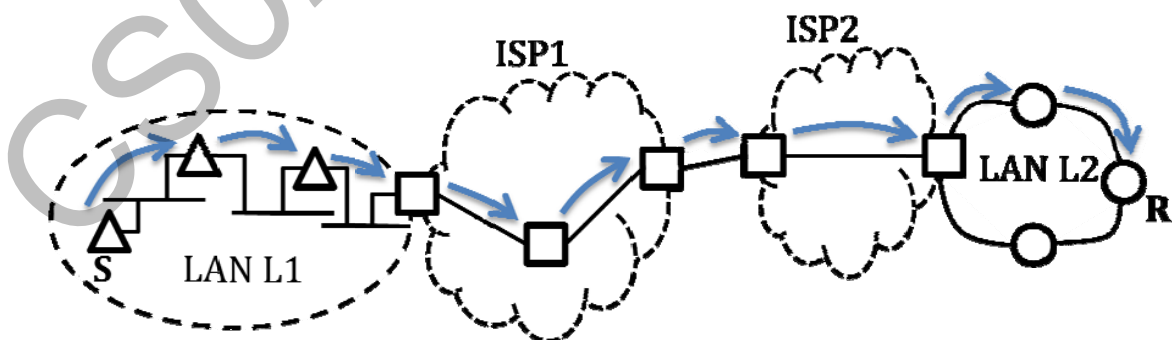
Q. 26 – Q. 55 carry two marks each.

Q.26　Consider the store and forward packet switched network given below. Assume that the bandwidth of each link is 10^6 bytes / sec. A user on host A sends a file of size 10^3 bytes to host B through routers R1 and R2 in three different ways. In the first case a single packet containing the complete file is transmitted from A to B. In the second case, the file is split into 10 equal parts, and these packets are transmitted from A to B. In the third case, the file is split into 20 equal parts and these packets are sent from A to B. Each packet contains 100 bytes of header information along with the user data. Consider only transmission time and ignore processing, queuing and propagation delays. Also assume that there are no errors during transmission. Let T1, T2 and T3 be the times taken to transmit the file in the first, second and third case respectively. Which one of the following is CORRECT?

```
[A] ——— [R1] ——— [R2] ——— [B]
```

(A) T1 < T2 < T3

(B) T1 > T2 > T3

(C) T2 = T3, T3 < T1

(D) T1 = T3, T3 > T2

Q.27　An IP machine Q has a path to another IP machine H via three IP routers R1, R2, and R3.

Q—R1—R2—R3—H

H acts as an HTTP server, and Q connects to H via HTTP and downloads a file. Session layer encryption is used, with DES as the shared key encryption protocol. Consider the following four pieces of information:

[I1] The URL of the file downloaded by Q
[I2] The TCP port numbers at Q and H
[I3] The IP addresses of Q and H
[I4] The link layer addresses of Q and H

Which of I1, I2, I3, and I4 can an intruder learn through sniffing at R2 alone?

(A) Only I1 and I2
(B) Only I1
(C) Only I2 and I3
(D) Only I3 and I4

Q.28   A graphical HTML browser resident at a network client machine Q accesses a static HTML webpage from a HTTP server S. The static HTML page has exactly one static embedded image which is also at S. Assuming no caching, which one of the following is correct about the HTML webpage loading (including the embedded image)?

(A) Q needs to send at least 2 HTTP requests to S, each necessarily in a separate TCP connection to server S

(B) Q needs to send at least 2 HTTP requests to S, but a single TCP connection to server S is sufficient

(C) A single HTTP request from Q to S is sufficient, and a single TCP connection between Q and S is necessary for this

(D) A single HTTP request from Q to S is sufficient, and this is possible without any TCP connection between Q and S

Q.29   Consider the following schedule **S** of transactions T1, T2, T3, T4:

T1	T2	T3	T4
	Reads(X)		
		Writes(X) Commit	
Writes(X) Commit			
	Writes(Y) Reads(Z) Commit		
			Reads(X) Reads(Y) Commit

Which one of the following statements is CORRECT?

(A) **S** is conflict-serializable but not recoverable

(B) **S** is not conflict-serializable but is recoverable

(C) **S** is both conflict-serializable and recoverable

(D) **S** is neither conflict-serializable nor is it recoverable

Q.30 Consider a join (relation algebra) between relations `r(R)` and `s(S)` using the nested loop method. There are 3 buffers each of size equal to disk block size, out of which one buffer is reserved for intermediate results. Assuming `size(r(R))<size(s(S))`, the join will have fewer number of disk block accesses if

(A) relation `r(R)` is in the outer loop.

(B) relation `s(S)` is in the outer loop.

(C) join selection factor between `r(R)` and `s(S)` is more than 0.5.

(D) join selection factor between `r(R)` and `s(S)` is less than 0.5.

Q.31 Consider the procedure below for the *Producer-Consumer* problem which uses semaphores:

```
semaphore n = 0;
semaphore s = 1;
void producer()                    void consumer()
{                                  {
    while(true)                        while(true)
    {                                  {
     produce();                         semWait(s);
     semWait(s);                        semWait(n);
     addToBuffer();                     removeFromBuffer();
     semSignal(s);                      semSignal(s);
     semSignal(n);                      consume();
    }                                  }
}                                  }
```

Which one of the following is **TRUE**?

(A) The producer will be able to add an item to the buffer, but the consumer can never consume it.

(B) The consumer will remove no more than one item from the buffer.

(C) Deadlock occurs if the consumer succeeds in acquiring semaphore **s** when the buffer is empty.

(D) The starting value for the semaphore **n** must be 1 and not 0 for deadlock-free operation.

Q.32　Three processes A, B and C each execute a loop of 100 iterations. In each iteration of the loop, a process performs a single computation that requires t_c CPU milliseconds and then initiates a single I/O operation that lasts for t_{io} milliseconds. It is assumed that the computer where the processes execute has sufficient number of I/O devices and the OS of the computer assigns different I/O devices to each process. Also, the scheduling overhead of the OS is negligible. The processes have the following characteristics:

Process id	t_c	t_{io}
A	100 ms	500 ms
B	350 ms	500 ms
C	200 ms	500 ms

The processes A, B, and C are started at times 0, 5 and 10 milliseconds respectively, in a pure time sharing system (round robin scheduling) that uses a time slice of 50 milliseconds. The time in milliseconds at which process C would *complete* its first I/O operation is _____.

Q.33　A computer has twenty physical page frames which contain pages numbered 101 through 120. Now a program accesses the pages numbered 1, 2, …, 100 in that order, and repeats the access sequence THRICE. Which one of the following page replacement policies experiences the same number of page faults as the optimal page replacement policy for this program?

(A) Least-recently-used　　　　　　　(B) First-in-first-out

(C) Last-in-first-out　　　　　　　　　(D) Most-recently-used

Q.34　For a C program accessing `X[i][j][k]`, the following intermediate code is generated by a compiler. Assume that the size of an `integer` is 32 bits and the size of a `character` is 8 bits.

```
t0 = i * 1024
t1 = j * 32
t2 = k * 4
t3 = t1 + t0
t4 = t3 + t2
t5 = X[t4]
```

Which one of the following statements about the source code for the C program is **CORRECT**?

(A)　`X` is declared as "`int X[32][32][8]`".

(B)　`X` is declared as "`int X[4][1024][32]`".

(C)　`X` is declared as "`char X[4][32][8]`".

(D)　`X` is declared as "`char X[32][16][2]`".

Q.35   Let $< M >$ be the encoding of a Turing machine as a string over $\Sigma = \{0, 1\}$. Let $L = \{ < M > \mid M \text{ is a Turing machine that accepts a string of length } 2014 \}$. Then, L is

(A) decidable and recursively enumerable

(B) undecidable but recursively enumerable

(C) undecidable and not recursively enumerable

(D) decidable but not recursively enumerable

Q.36   Let $L_1 = \{w \in \{0,1\}^* \mid w$ has at least as many occurrences of (110)'s as (011)'s}. Let $L_2 = \{w \in \{0,1\}^* \mid w$ has at least as many occurrences of (000)'s as (111)'s}. Which one of the following is TRUE?

(A) L_1 is regular but not L_2

(B) L_2 is regular but not L_1

(C) Both L_1 and L_2 are regular

(D) Neither L_1 nor L_2 are regular

Q.37   Consider two strings $A = "qpqrr"$ and $B = "pqprqrp"$. Let x be the length of the longest common subsequence (not necessarily contiguous) between A and B and let y be the number of such longest common subsequences between A and B. Then $x + 10y = $ ___.

Q.38   Suppose P, Q, R, S, T are sorted sequences having lengths 20, 24, 30, 35, 50 respectively. They are to be merged into a single sequence by merging together two sequences at a time. The number of comparisons that will be needed in the worst case by the optimal algorithm for doing this is _____.

Q.39 Consider the expression tree shown. Each leaf represents a numerical value, which can either be 0 or 1. Over all possible choices of the values at the leaves, the maximum possible value of the expression represented by the tree is ___.
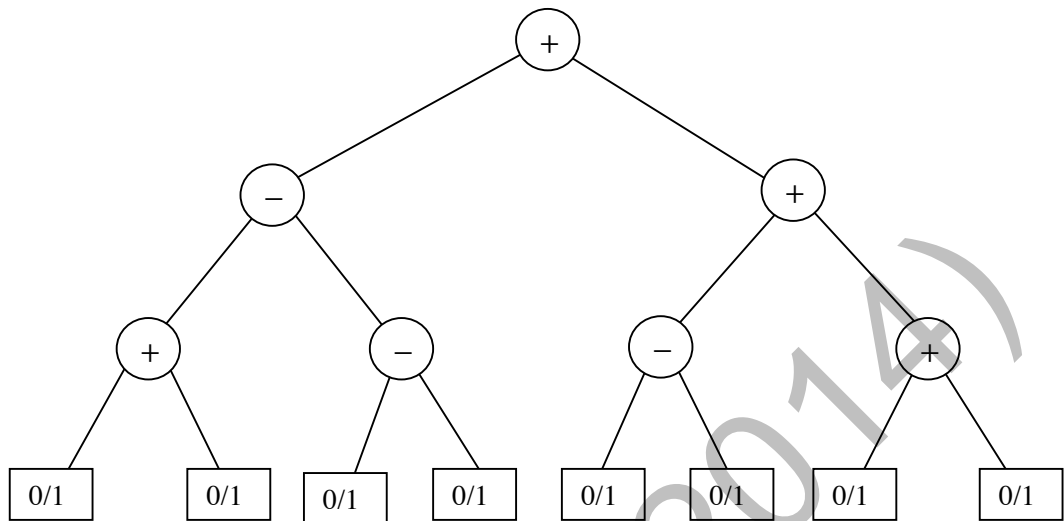
Q.40 Consider the following function

```
double f(double x){
    if( abs(x*x - 3) < 0.01) return x;
    else return f(x/2 + 1.5/x);
}
```

Give a value q (to 2 decimals) such that f(q) will return q:_____.

Q.41 Suppose a stack implementation supports an instruction REVERSE, which reverses the order of elements on the stack, in addition to the PUSH and POP instructions. Which one of the following statements is TRUE *with respect to this modified stack*?

(A) A queue cannot be implemented using this stack.

(B) A queue can be implemented where ENQUEUE takes a single instruction and DEQUEUE takes

a sequence of two instructions.

(C) A queue can be implemented where ENQUEUE takes a sequence of three instructions and

DEQUEUE takes a single instruction.

(D) A queue can be implemented where both ENQUEUE and DEQUEUE take a single instruction

each.

Q.42 Consider the C function given below.

```
int f(int j)
{
  static int i = 50;
  int k;
  if (i == j)
      {
        printf("something");
        k = f(i);
        return 0;
      }
  else return 0;
}
```

Which one of the following is **TRUE**?

(A) The function returns **0** for all values of **j**.

(B) The function prints the string **something** for all values of **j**.

(C) The function returns **0** when **j = 50**.

(D) The function will exhaust the runtime stack or run into an infinite loop when **j = 50**.

Q.43 In designing a computer's cache system, the cache block (or cache line) size is an important parameter. Which one of the following statements is correct in this context?

(A) A smaller block size implies better spatial locality

(B) A smaller block size implies a smaller cache tag and hence lower cache tag overhead

(C) A smaller block size implies a larger cache tag and hence lower cache hit time

(D) A smaller block size incurs a lower cache miss penalty

Q.44 If the associativity of a processor cache is doubled while keeping the capacity and block size unchanged, which one of the following is guaranteed to be NOT affected?

(A) Width of tag comparator   (B) Width of set index decoder

(C) Width of way selection multiplexor   (D) Width of processor to main memory data bus

Q.45 The value of a *float* type variable is represented using the single-precision 32-bit floating point format of IEEE-754 standard that uses 1 bit for sign, 8 bits for biased exponent and 23 bits for mantissa. A *float* type variable X is assigned the decimal value of -14.25. The representation of X in hexadecimal notation is

(A) C1640000H   (B) 416C0000H   (C) 41640000H   (D) C16C0000H

Q.46   In the Newton-Raphson method, an initial guess of $x_0 = 2$ is made and the sequence $x_0, x_1, x_2 \ldots$ is obtained for the function

$$0.75x^3 - 2x^2 - 2x + 4 = 0$$

Consider the statements
   (I) $x_3 = 0$.
   (II)   The method converges to a solution in a finite number of iterations.

Which of the following is TRUE?

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

Q.47   The product of the non-zero eigenvalues of the matrix

$$\begin{bmatrix} 1 & 0 & 0 & 0 & 1 \\ 0 & 1 & 1 & 1 & 0 \\ 0 & 1 & 1 & 1 & 0 \\ 0 & 1 & 1 & 1 & 0 \\ 1 & 0 & 0 & 0 & 1 \end{bmatrix}$$

is _____.

Q.48   The probability that a given positive integer lying between 1 and 100 (both inclusive) is NOT divisible by 2, 3 or 5 is _____ .

Q.49   The number of distinct positive integral factors of 2014 is _____ _____

Q.50   Consider the following relation on subsets of the set S of integers between 1 and 2014. For two distinct subsets U and V of S we say $U < V$ if the minimum element in the symmetric difference of the two sets is in U.

Consider the following two statements:

$S1$: There is a subset of S that is larger than every other subset.
$S2$: There is a subset of S that is smaller than every other subset.

Which one of the following is CORRECT?

(A) Both $S1$ and $S2$ are true

(B) $S1$ is true and $S2$ is false

(C) $S2$ is true and $S1$ is false

(D) Neither $S1$ nor $S2$ is true

Q.51 A cycle on n vertices is isomorphic to its complement. The value of n is _____.

Q.52 The number of distinct minimum spanning trees for the weighted graph below is _____
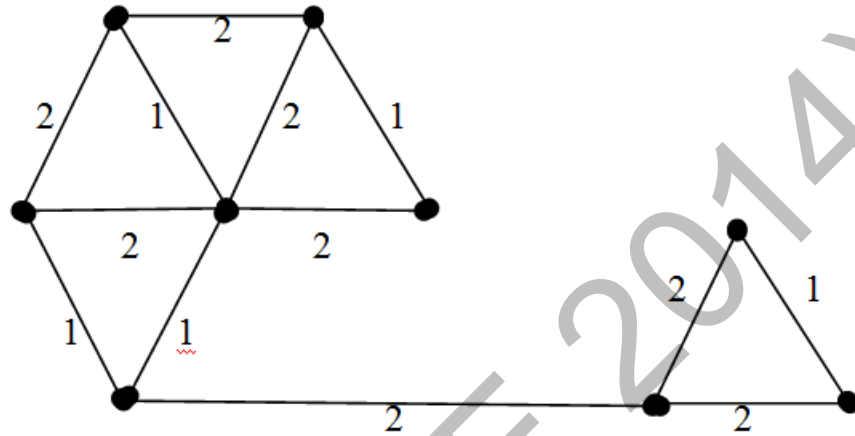
Q.53 Which one of the following Boolean expressions is NOT a tautology?

(A) $((a \rightarrow b) \wedge (b \rightarrow c)) \rightarrow (a \rightarrow c)$

(B) $(a \leftrightarrow c) \rightarrow (\sim b \rightarrow (a \wedge c))$

(C) $(a \wedge b \wedge c) \rightarrow (c \vee a)$

(D) $a \rightarrow (b \rightarrow a)$

Q.54 SQL allows duplicate tuples in relations, and correspondingly defines the multiplicity of tuples in the result of joins. Which one of the following queries always gives the same answer as the nested query shown below:

```
select * from R where a in (select S.a from S)
```

(A) `select R.* from R, S where R.a=S.a`

(B) `select distinct R.* from R,S where R.a=S.a`

(C) `select R.* from R,(select distinct a from S) as S1 where R.a=S1.a`

(D) `select R.* from R,S where R.a=S.a and is unique R`

Q.55   Consider a main memory system that consists of 8 memory modules attached to the system bus, which is one word wide. When a write request is made, the bus is occupied for 100 nanoseconds (ns) by the data, address, and control signals. During the same 100 ns, and for 500 ns thereafter, the addressed memory module executes one cycle accepting and storing the data. The (internal) operation of different memory modules may overlap in time, but only one request can be on the bus at any time. The maximum number of stores (of one word each) that can be initiated in 1 millisecond is _____

END OF THE QUESTION PAPER