# SESSION - 1

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   Which of the following options is the closest in meaning to the phrase underlined in the sentence below?

It is fascinating to see life forms <u>cope with</u> varied environmental conditions.

(A) adopt to   (B) adapt to   (C) adept in   (D) accept with

Q.2   Choose the most appropriate word from the options given below to complete the following sentence.

He could not understand the judges awarding her the first prize, because he thought that her performance was quite _____.

(A) superb   (B) medium   (C) mediocre   (D) exhilarating

Q.3   In a press meet on the recent scam, the minister said, "The buck stops here". What did the minister convey by the statement?

(A) He wants all the money   (B) He will return the money
(C) He will assume final responsibility   (D) He will resist all enquiries

Q.4   If $(z + 1/z)^2 = 98$, compute $(z^2 + 1/z^2)$.

Q.5   The roots of $ax^2 + bx + c = 0$ are real and positive. a, b and c are real. Then $ax^2 + b|x| + c = 0$ has

(A) no roots   (B) 2 real roots
(C) 3 real roots   (D) 4 real roots

Q. 6 – Q. 10 carry two marks each.

Q.6   The Palghat Gap (or Palakkad Gap), a region about 30 km wide in the southern part of the Western Ghats in India, is lower than the hilly terrain to its north and south. The exact reasons for the formation of this gap are not clear. It results in the neighbouring regions of Tamil Nadu getting more rainfall from the South West monsoon and the neighbouring regions of Kerala having higher summer temperatures.

What can be inferred from this passage?

(A) The Palghat gap is caused by high rainfall and high temperatures in southern Tamil Nadu and Kerala
(B) The regions in Tamil Nadu and Kerala that are near the Palghat Gap are low-lying
(C) The low terrain of the Palghat Gap has a significant impact on weather patterns in neighbouring parts of Tamil Nadu and Kerala
(D) Higher summer temperatures result in higher rainfall near the Palghat Gap area

Q.7   Geneticists say that they are very close to confirming the genetic roots of psychiatric illnesses such as depression and schizophrenia, and consequently, that doctors will be able to eradicate these diseases through early identification and gene therapy.

On which of the following assumptions does the statement above rely?

(A) Strategies are now available for eliminating psychiatric illnesses
(B) Certain psychiatric illnesses have a genetic basis
(C) All human diseases can be traced back to genes and how they are expressed
(D) In the future, genetics will become the only relevant field for identifying psychiatric illnesses

Q.8   Round-trip tickets to a tourist destination are eligible for a discount of 10% on the total fare. In addition, groups of 4 or more get a discount of 5% on the total fare. If the one way single person fare is Rs 100, a group of 5 tourists purchasing round-trip tickets will be charged Rs _____.

Q.9   In a survey, 300 respondents were asked whether they own a vehicle or not. If yes, they were further asked to mention whether they own a car or scooter or both. Their responses are tabulated below. What percent of respondents do not own a scooter?

		Men	Women
	Car	40	34
Own vehicle	Scooter	30	20
	Both	60	46
Do not own vehicle		20	50

Q.10 When a point inside of a tetrahedron (a solid with four triangular surfaces) is connected by straight lines to its corners, how many (new) internal planes are created with these lines? _____

END OF THE QUESTION PAPER

Q. 1 – Q. 25 carry one mark each.

Q.1   Consider the statement

<p style="text-align:center">"Not all that glitters is gold"</p>

Predicate $glitters(x)$ is true if x glitters and predicate $gold(x)$ is true if x is gold. Which one of the following logical formulae represents the above statement?

(A) $\forall x:\ glitters\ (x)\ \Rightarrow \neg gold(x)$

(B) $\forall x:\ gold\ (x)\ \Rightarrow glitters(x)$

(C) $\exists x:\ gold\ (x) \wedge \neg\ glitters\ (x)$

(D) $\exists x:\ glitters\ (x)\ \wedge \neg\ gold\ (x)$

Q.2   Suppose you break a stick of unit length at a point chosen uniformly at random. Then the expected length of the shorter stick is _____ .

Q.3   Let $G=(V,E)$ be a directed graph where V is the set of vertices and E the set of edges. Then which one of the following graphs has the same strongly connected components as G ?

(A) $G_1 = (V, E_1)$ where $E_1 = \{(u,v) | (u,v) \notin E\}$

(B) $G_2 = (V, E_2)$ where $E_2 = \{(u,v) | (v,u) \in E\}$

(C) $G_3 = (V, E_3)$ where $E_3 = \{(u,v) | there\ is\ a\ path\ of\ length \leq 2\ from\ u\ to\ v\ in\ E\}$

(D) $G_4 = (V_4, E)$ where V_4 is the set of vertices in G which are not isolated

Q.4   Consider the following system of equations:

```
3x + 2y = 1
4x + 7z = 1
x + y + z = 3
x – 2y + 7z = 0
```

The number of solutions for this system is _____

Q.5   The value of the dot product of the eigenvectors corresponding to any pair of different eigenvalues of a 4-*by*-4 symmetric positive definite matrix is _____.

Q.6   Let the function

$$f(\theta) = \begin{vmatrix} \sin\theta & \cos\theta & \tan\theta \\ \sin(\pi/6) & \cos(\pi/6) & \tan(\pi/6) \\ \sin(\pi/3) & \cos(\pi/3) & \tan(\pi/3) \end{vmatrix}$$

where $\theta \in \left[\frac{\pi}{6}, \frac{\pi}{3}\right]$ and $f'(\theta)$ denote the derivative of f with respect to θ. Which of the following statements is/are **TRUE**?

(I)   There exists $\theta \in (\frac{\pi}{6}, \frac{\pi}{3})$ such that $f'(\theta) = 0$.

(II)   There exists $\theta \in (\frac{\pi}{6}, \frac{\pi}{3})$ such that $f'(\theta) \neq 0$.

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

Q.7   Consider the following Boolean expression for F:

$$F(P, Q, R, S) = PQ + \bar{P}QR + \bar{P}Q\bar{R}S$$

The minimal sum-of-products form of F is

(A) $PQ + QR + QS$ (B) $P + Q + R + S$ (C) $\bar{P} + \bar{Q} + \bar{R} + \bar{S}$ (D) $\bar{P}R + \bar{P}\bar{R}S + P$

Q.8   The base (or radix) of the number system such that the following equation holds is_____.

$$\frac{312}{20} = 13.1$$

Q.9   A machine has a 32-bit architecture, with 1-word long instructions. It has 64 registers, each of which is 32 bits long. It needs to support 45 instructions, which have an immediate operand in addition to two register operands. Assuming that the immediate operand is an unsigned integer, the maximum value of the immediate operand is _____.

Q.10   Consider the following program in C language:

```
#include <stdio.h>

main()
{
 int i;
 int *pi = &i;

 scanf("%d",pi);
 printf("%d\n", i+5);
}
```

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

(A) Compilation fails.

(B) Execution results in a run-time error.

(C) On execution, the value printed is **5** more than the address of variable **i**.

(D) On execution, the value printed is **5** more than the integer value entered.

Q.11   Let G be a graph with n vertices and m edges. What is the tightest upper bound on the running time of Depth First Search on G, when G is represented as an adjacency matrix?

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

Q.12   Consider a rooted n node binary tree represented using pointers. The best upper bound on the time required to determine the number of subtrees having exactly 4 nodes is $O(n^a \log^b n)$. Then the value of $a + 10b$ is _____.

Q.13   Consider the directed graph given below.
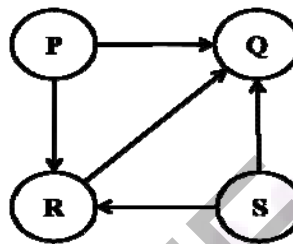
Which one of the following is **TRUE**?

(A)   The graph does not have any topological ordering.

(B)   Both PQRS and SRQP are topological orderings.

(C)   Both PSRQ and SPRQ are topological orderings.

(D)   PSRQ is the only topological ordering.

Q.14   Let P be a quicksort program to sort numbers in ascending order using the first element as the pivot. Let t_1 and t_2 be the number of comparisons made by P for the inputs [1 2 3 4 5] and [4 1 5 3 2] respectively. Which one of the following holds?

(A) $t_1 = 5$ (B) $t_1 < t_2$

(C) $t_1 > t_2$ (D) $t_1 = t_2$

Q.15   Which one of the following is **TRUE**?

(A) The language $L = \{a^n b^n \mid n \geq 0\}$ is regular.

(B) The language $L = \{a^n \mid n \ is \ prime\}$ is regular.

(C) The language $L = \{w \mid w \ has \ 3k + 1 \ b's \ for \ some \ k \in \ \mathbb{N} \ with \ \Sigma = \{a, b\}\}$ is regular.

(D) The language $L = \{ ww \mid w \ \epsilon \ \Sigma^* \ with \ \Sigma = \{0,1\}\}$ is regular.

Q.16   Consider the finite automaton in the following figure.
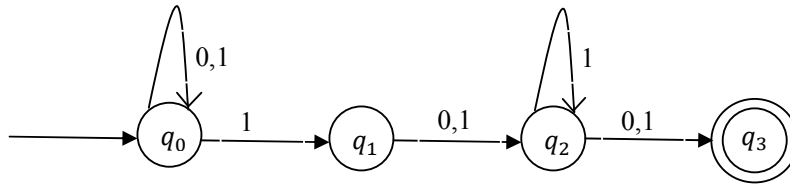
What is the set of reachable states for the input string 0011?

(A) $\{q_0, q_1, q_2\}$
(B) $\{q_0, q_1\}$
(C) $\{q_0, q_1, q_2, q_3\}$
(D) $\{q_3\}$

Q.17   Which one of the following is **FALSE**?
(A) A basic block is a sequence of instructions where control enters the sequence at the beginning and exits at the end.
(B) Available expression analysis can be used for common subexpression elimination.
(C) Live variable analysis can be used for dead code elimination.
(D) $x = 4 * 5 \Rightarrow x = 20$ is an example of common subexpression elimination.

Q.18   Match the following:

1) Waterfall model   a) Specifications can be developed incrementally

2) Evolutionary model   b) Requirements compromises are inevitable

3) Component-based software engineering   c) Explicit recognition of risk

4) Spiral development   d) Inflexible partitioning of the project into stages

(A) 1-a, 2-b, 3-c, 4-d   (B) 1-d, 2-a, 3-b, 4-c
(C) 1-d, 2-b, 3-a, 4-c   (D) 1-c, 2-a, 3-b, 4-d

Q.19   Suppose a disk has 201 cylinders, numbered from 0 to 200. At some time the disk arm is at cylinder 100, and there is a queue of disk access requests for cylinders 30, 85, 90, 100, 105, 110, 135 and 145. If Shortest-Seek Time First (SSTF) is being used for scheduling the disk access, the request for cylinder 90 is serviced after servicing _____ number of requests.

Q.20   Which one of the following is **FALSE**?

     (A)   User level threads are not scheduled by the kernel.

     (B)   When a user level thread is blocked, all other threads of its process are blocked.

     (C)   Context switching between user level threads is faster than context switching between kernel level threads.

     (D)   Kernel level threads cannot share the code segment.

Q.21   Consider the relation scheme $R = (E, F, G, H, I, J, K, L, M, N)$ and the set of functional dependencies $\{\{E,F\} \to \{G\}, \{F\} \to \{I,J\}, \{E,H\} \to \{K,L\}, \{K\} \to \{M\}, \{L\} \to \{N\}\}$ on R. What is the key for R?

     (A) $\{E,F\}$ (B) $\{E,F,H\}$ (C) $\{E,F,H,K,L\}$ (D) $\{E\}$

Q.22   Given the following statements:

         S1: A foreign key declaration can always be replaced by an equivalent check assertion in SQL.

         S2: Given the table R(a,b,c) where a and b together form the primary key, the following is a valid table definition.

```
CREATE TABLE S (
    a INTEGER,
    d INTEGER,
    e INTEGER,
    PRIMARY KEY (d),
    FOREIGN KEY (a) references R)
```

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

(A) S1 is TRUE and S2 is FALSE.

(B) Both S1 and S2 are TRUE.

(C) S1 is FALSE and S2 is TRUE.

(D) Both S1 and S2 are FALSE.

Q.23   Consider the following three statements about link state and distance vector routing protocols, for a large network with 500 network nodes and 4000 links.

[S1] The computational overhead in link state protocols is higher than in distance vector protocols.
[S2] A distance vector protocol (with split horizon) avoids persistent routing loops, but not a link state protocol.
[S3] After a topology change, a link state protocol will converge faster than a distance vector protocol.

Which one of the following is correct about S1, S2, and S3 ?

(A) S1, S2, and S3 are all true.   (B) S1, S2, and S3 are all false.

(C) S1 and S2 are true, but S3 is false.   (D) S1 and S3 are true, but S2 is false.

Q.24   Which of the following are used to generate a message digest by the network security protocols?

(P) RSA   (Q) SHA-1   (R) DES   (S) MD5

(A) P and R only   (B) Q and R only

(C) Q and S only   (D) R and S only

Q.25   Identify the correct order in which the following actions take place in an interaction between a web browser and a web server.

1.   The web browser requests a webpage using HTTP.
2.   The web browser establishes a TCP connection with the web server.
3.   The web server sends the requested webpage using HTTP.
4.   The web browser resolves the domain name using DNS.

(A) 4,2,1,3   (B) 1,2,3,4   (C) 4,1,2,3   (D) 2,4,1,3

Q. 26 – Q. 55 carry two marks each.

Q.26   Consider a token ring network with a length of 2 km having 10 stations including a monitoring station. The propagation speed of the signal is 2×10^8 m/s and the token transmission time is ignored. If each station is allowed to hold the token for 2 μsec, the minimum time for which the monitoring station should wait (**in μsec**)before assuming that the token is lost is _____.

Q.27   Let the size of congestion window of a TCP connection be 32 KB when a timeout occurs. The round trip time of the connection is 100 msec and the maximum segment size used is 2 KB. The time taken (**in msec**) by the TCP connection to get back to 32 KB congestion window is _____.

Q.28   Consider a selective repeat sliding window protocol that uses a frame size of 1 KB to send data on a 1.5 Mbps link with a one-way latency of 50 msec. To achieve a link utilization of 60%, the minimum number of bits required to represent the sequence number field is _____.

Q.29   Consider the following four schedules due to three transactions (indicated by the subscript) using *read* and *write* on a data item x, denoted by $r(x)$ and $w(x)$ respectively. Which one of them is conflict serializable?

     (A) $r_1(x)$; $r_2(x)$; $w_1(x)$; $r_3(x)$; $w_2(x)$

     (B) $r_2(x)$; $r_1(x)$; $w_2(x)$; $r_3(x)$; $w_1(x)$

     (C) $r_3(x)$; $r_2(x)$; $r_1(x)$; $w_2(x)$; $w_1(x)$

     (D) $r_2(x)$; $w_2(x)$; $r_3(x)$; $r_1(x)$; $w_1(x)$

Q.30   Given the following two statements:

     S1: Every table with two single-valued attributes is in 1NF, 2NF, 3NF and BCNF.

     S2: AB→C, D→E, E→C is a minimal cover for the set of functional dependencies AB→C, D→E, AB→E, E→C.

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

     (A) S1 is TRUE and S2 is FALSE.

     (B) Both S1 and S2 are TRUE.

     (C) S1 is FALSE and S2 is TRUE.

     (D) Both S1 and S2 are FALSE.

Q.31 An operating system uses the *Banker's algorithm* for deadlock avoidance when managing the allocation of three resource types X, Y, and Z to three processes P0, P1, and P2. The table given below presents the current system state. Here, the *Allocation* matrix shows the current number of resources of each type allocated to each process and the *Max* matrix shows the maximum number of resources of each type required by each process during its execution.

	Allocation			Max		
	X	Y	Z	X	Y	Z
P0	0	0	1	8	4	3
P1	3	2	0	6	2	0
P2	2	1	1	3	3	3

There are 3 units of type X, 2 units of type Y and 2 units of type Z still available. The system is currently in a **safe** state. Consider the following independent requests for additional resources in the current state:

REQ1: P0 requests 0 units of X, 0 units of Y and 2 units of Z
REQ2: P1 requests 2 units of X, 0 units of Y and 0 units of Z

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

(A) Only REQ1 can be permitted.

(B) Only REQ2 can be permitted.

(C) Both REQ1 and REQ2 can be permitted.

(D) Neither REQ1 nor REQ2 can be permitted.

Q.32 Consider the following set of processes that need to be scheduled on a single CPU. All the times are given in milliseconds.

Process Name	Arrival Time	Execution Time
A	0	6
B	3	2
C	5	4
D	7	6
E	10	3

Using the *shortest remaining time first* scheduling algorithm, the average process turnaround time (in msec) is _____.

Q.33 Assume that there are 3 page frames which are initially empty. If the page reference string is 1, 2, 3, 4, 2, 1, 5, 3, 2, 4, 6, the number of page faults using the *optimal replacement policy* is_____.

Q.34 A canonical set of items is given below

$$S \rightarrow L . > R$$
$$Q \rightarrow R .$$

On input symbol < the set has

(A) a shift-reduce conflict and a reduce-reduce conflict.

(B) a shift-reduce conflict but not a reduce-reduce conflict.

(C) a reduce-reduce conflict but not a shift-reduce conflict.

(D) neither a shift-reduce nor a reduce-reduce conflict.

Q.35   Let L be a language and $\bar{L}$ be its complement. Which one of the following is NOT a viable possibility?

(A) Neither L nor $\bar{L}$ is recursively enumerable (r.e.).

(B) One of L and $\bar{L}$ is r.e. but not recursive; the other is not r.e.

(C) Both L and $\bar{L}$ are r.e. but not recursive.

(D) Both L and $\bar{L}$ are recursive.

Q.36   Which of the regular expressions given below represent the following DFA?
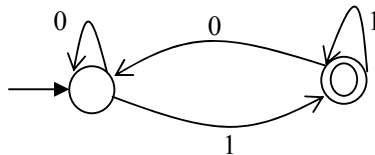
  I)   0*1(1+00*1)*
  II)   0*1*1+11*0*1
  III) (0+1)*1

(A) I and II only   (B) I and III only

(C) II and III only   (D) I, II, and III

Q.37   There are 5 bags labeled 1 to 5. All the coins in a given bag have the same weight. Some bags have coins of weight 10 gm, others have coins of weight 11 gm. I pick 1, 2, 4, 8, 16 coins respectively from bags 1 to 5. Their total weight comes out to 323 gm. Then the product of the labels of the bags having 11 gm coins is ___.

Q.38   Suppose a polynomial time algorithm is discovered that correctly computes the largest clique in a given graph. In this scenario, which one of the following represents the correct Venn diagram of the complexity classes P, NP and NP Complete (NPC)?

(A)

(B)

(C)

(D)
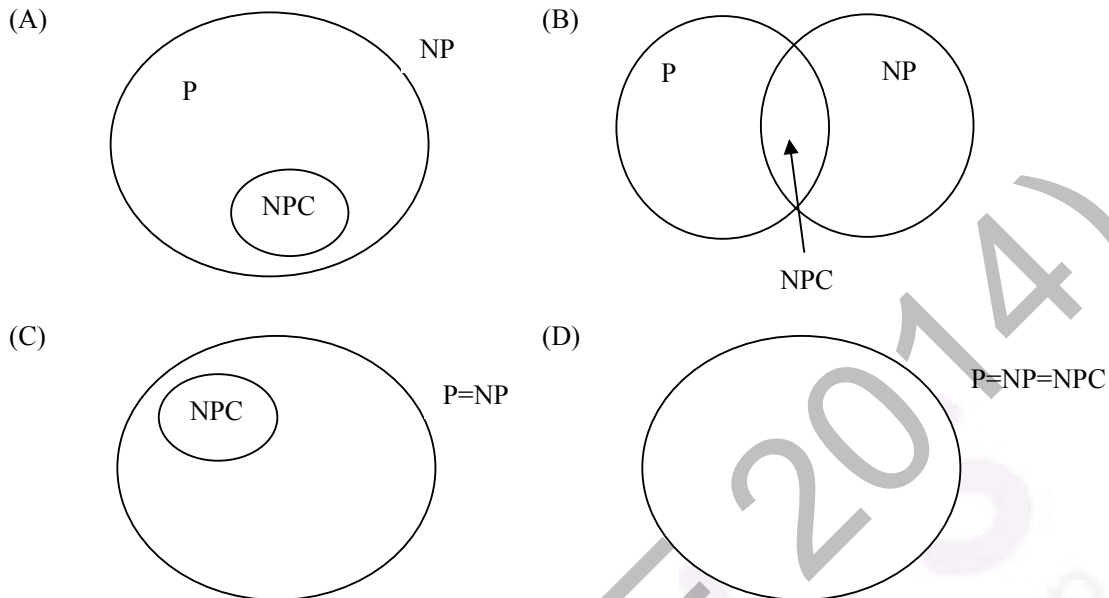
Q.39   The minimum number of comparisons required to find the minimum and the maximum of 100 numbers is _____.

Q.40   Consider a hash table with 9 slots. The hash function is $h(k) = k \bmod 9$. The collisions are resolved by chaining. The following 9 keys are inserted in the order: 5, 28, 19, 15, 20, 33, 12, 17, 10. The maximum, minimum, and average chain lengths in the hash table, respectively, are

(A)   3, 0, and 1

(B)   3, 3, and 3

(C)   4, 0, and 1

(D)   3, 0, and 2

Q.41   Consider the following C function in which **size** is the number of elements in the array **E**:

```
int MyX(int *E, unsigned int size)
{
  int Y = 0;
  int Z;
  int i, j, k;

  for(i = 0; i < size; i++)
      Y = Y + E[i];

  for(i = 0; i < size; i++)
      for(j = i; j < size; j++)
      {
          Z = 0;
          for(k = i; k <= j; k++)
              Z = Z + E[k];
          if (Z > Y)
              Y = Z;
      }
  return Y;
}
```

The value returned by the function **MyX** is the

(A) maximum possible sum of elements in any sub-array of array **E**.

(B) maximum element in any sub-array of array **E**.

(C) sum of the maximum elements in all possible sub-arrays of array **E**.

(D) the sum of all the elements in the array **E**.

Q.42   Consider the following pseudo code. What is the total number of multiplications to be performed?

```
 D = 2
 for i = 1 to n do
     for j = i to n do
         for k =  j + 1 to n do
             D = D * 3
```

(A) Half of the product of the 3 consecutive integers.

(B) One-third of the product of the 3 consecutive integers.

(C) One-sixth of the product of the 3 consecutive integers.

(D) None of the above.

Q.43   Consider a 6-stage instruction pipeline, where all stages are perfectly balanced.Assume that there is no cycle-time overhead of pipelining. When an application is executing on this 6-stage pipeline, the speedup achieved with respect to non-pipelined execution if 25% of the instructions incur 2 pipeline stall cycles is _____.

Q.44   An access sequence of cache block addresses is of length N and contains n unique block addresses. The number of unique block addresses between two consecutive accesses to the same block address is bounded above by k. What is the miss ratio if the access sequence is passed through a cache of associativity $A \geq k$ exercising least-recently-used replacement policy?

(A) n/N (B) $1/N$ (C) $1/A$ (D) k/n

Q.45   Consider the 4-to-1 multiplexer with two select lines S_1 and S_0 given below.
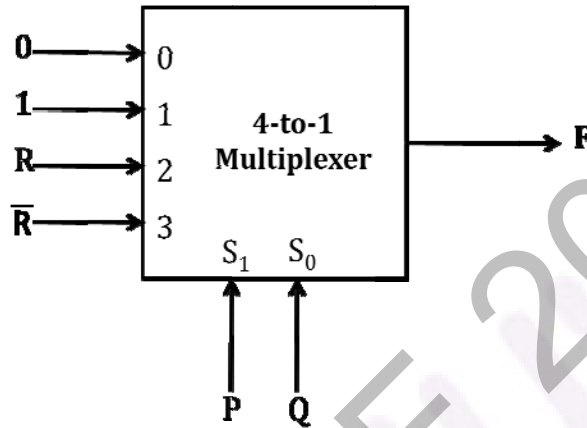
The minimal sum-of-products form of the Boolean expression for the output F of the multiplexer is

(A) $\bar{P}Q + Q\bar{R} + P\bar{Q}R$

(B) $\bar{P}Q + \bar{P}Q\bar{R} + PQ\bar{R} + P\bar{Q}R$

(C) $\bar{P}QR + \bar{P}Q\bar{R} + Q\bar{R} + P\bar{Q}R$

(D) $PQ\bar{R}$

Q.46   The function $f(x) = x \sin x$ satisfies the following equation: $f''(x) + f(x) + t \cos x = 0$. The value of t is _____.

Q.47   A function $f(x)$ is continuous in the interval [0,2]. It is known that $f(0) = f(2) = -1$ and $f(1) = 1$. Which one of the following statements must be true?

(A) There exists a y in the interval $(0,1)$ such that $f(y) = f(y + 1)$

(B) For every y in the interval $(0,1), f(y) = f(2 - y)$

(C) The maximum value of the function in the interval $(0,2)$ is 1

(D) There exists a y in the interval $(0,1)$ such that $f(y) = -f(2 - y)$

Q.48   Four fair six-sided dice are rolled. The probability that the sum of the results being 22 is $X/1296$. The value of X is _____.

Q.49 A pennant is a sequence of numbers, each number being 1 or 2. An n-pennant is a sequence of numbers with sum equal to n. For example, (1,1,2) is a 4-pennant. The set of all possible 1-pennants is {(1)}, the set of all possible 2-pennants is {(2), (1,1)} and the set of all 3-pennants is {(2,1), (1,1,1), (1,2)}. Note that the pennant (1,2) is not the same as the pennant (2,1). The number of 10-pennants is _____.

Q.50 Let S denote the set of all functions $f: \{0,1\}^4 \to \{0,1\}$. Denote by N the number of functions from S to the set $\{0,1\}$. The value of $log_2\ log_2 N$ is _____.

Q.51 Consider an undirected graph G where self-loops are not allowed. The vertex set of G is $\{(i,j): 1 \leq i \leq 12, 1 \leq j \leq 12\}$. There is an edge between (a,b) and (c,d) if $|a-c| \leq 1$ and $|b-d| \leq 1$. The number of edges in this graph is _____.

Q.52 An ordered n-tuple $(d_1, d_2, ..., d_n)$ with $d_1 \geq d_2 \geq \cdots \geq d_n$ is called *graphic* if there exists a simple undirected graph with n vertices having degrees $d_1, d_2, ..., d_n$ respectively. Which of the following 6-tuples is NOT graphic?

(A) (1, 1, 1, 1, 1, 1)   (B) (2, 2, 2, 2, 2, 2)

(C) (3, 3, 3, 1, 0, 0)   (D) (3, 2, 1, 1, 1, 0)

Q.53 Which one of the following propositional logic formulas is TRUE when exactly two of p, q, and r are **TRUE**?

(A) $\big((p \leftrightarrow q) \wedge r\big) \vee (p \wedge q \wedge \sim r)$

(B) $(\sim (p \leftrightarrow q) \wedge r) \vee (p \wedge q \wedge \sim r)$

(C) $\big((p \to q) \wedge r\big) \vee (p \wedge q \wedge \sim r)$

(D) $(\sim (p \leftrightarrow q) \wedge r) \wedge (p \wedge q \wedge \sim r)$

Q.54   Given the following schema:
```
employees(emp-id, first-name, last-name, hire-date,
          dept-id, salary)
departments(dept-id, dept-name, manager-id, location-id)
```

You want to display the last names and hire dates of all latest hires in their respective departments in the location ID 1700. You issue the following query:

```
SQL>SELECT last-name, hire-date
    FROM employees
    WHERE (dept-id, hire-date) IN
    (SELECT dept-id, MAX(hire-date)
    FROM employees JOIN departments USING(dept-id)
    WHERE location-id = 1700
    GROUP BY dept-id);
```

What is the outcome?

(A) It executes but does not give the correct result.

(B) It executes and gives the correct result.

(C) It generates an error because of pairwise comparison.

(D) It generates an error because the GROUP BY clause cannot be used with table joins in a sub-query.

Q.55   Consider two processors P_1 and P_2 executing the same instruction set. Assume that under identical conditions, for the same input, a program running on P_2 takes 25% less time but incurs 20% more CPI (clock cycles per instruction) as compared to the program running on P_1. If the clock frequency of P_1 is 1GHz, then the clock frequency of P_2 (in GHz) is _____.

END OF THE QUESTION PAPER