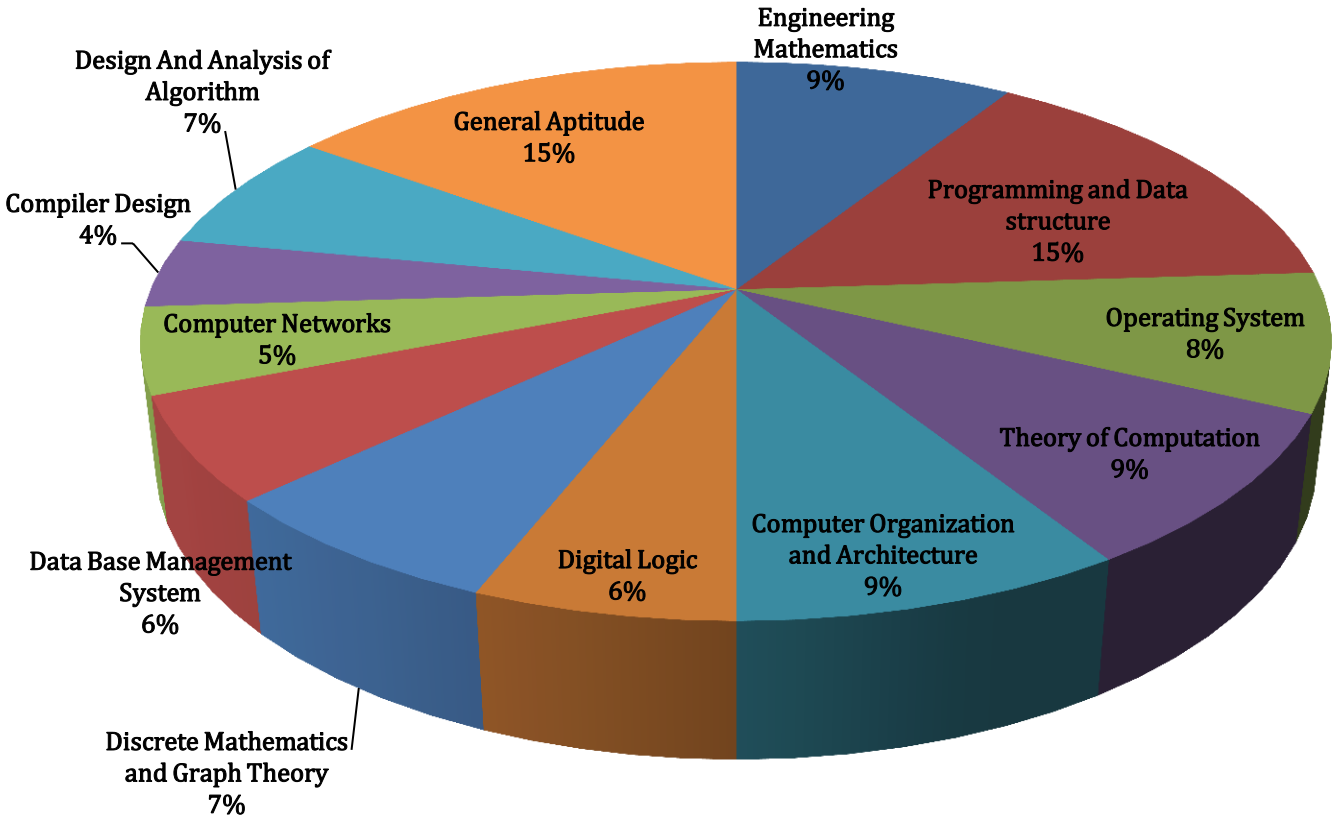
ANALYSIS OF GATE 2017*
Computer Science and Information Technology



CS ANALYSIS-2017_11-Feb_Morning

SUBJECT	Ques. No.	Topics Asked in Paper(Memory Based)	Level of Toughness	Total Marks
Engineering Mathematics	1 Marks: 3 2 Marks: 3	Linear Algebra; Probability and Distribution	Medium	**9**
Programming and Data structure	1 Marks: 3 2 Marks: 6	Graph; C Programming; Stack and Queue/Linked List; C Programming; tree	Tough	**15**
Operating System	1 Marks: 2 2 Marks: 3	Thread/Process Management; File system; Process management; CPU Scheduling; Memory management	Easy	**8**
Theory of Computation	1 Marks: 3 2 Marks: 3	Contex free Grammar; Regular Expression; Contex free Grammar; Regular expression Finite Automata; Turing machine	Easy	**9**
Computer Organization and Architecture	1 Marks: 3 2 Marks: 3	Introduction; Memory	Medium	**9**
Digital Logic	1 Marks: 0 2 Marks: 2	Combinational and Sequential Digital Circuits Boolean Algebra and Karnaugh Maps	Easy	**6**
Discrete Mathematics and Graph Theory	1 Marks: 3 2 Marks: 2	Graph; Mathematical Logic; Set and Relation; Combinatrics	Easy	**7**
Data Base Management System	1 Marks: 2 2 Marks: 2	Transactions and Concurrency Control; ER diagrams; SQL	Medium	**6**
Computer Networks	1 Marks: 3 2 Marks: 1	TCP/IP, UDP and Sockets, IPv4; Routing & Congestion Control; Physical Layers	Easy	**5**
Compiler Design	1 Marks: 2 2 Marks: 1	Parsing; Introduction to Compilers	Easy	**4**
Design And Analysis of Algorithm	1 Marks: 1 2 Marks: 3	Algorithm Analysis; Greedy Techniques	Medium	**7**
General Aptitude	1 Marks: 5 2 Marks: 5	Numerical Ability; Verbal Ability	Medium	**15**
Total	**65**			**100**
Faculty Feedback	Majority of the question were direct concept based. DS, COA, Maths and TOC weightage was comparatively high. GA was medium as compared to the last year.			

GATE 2017 Examination

Computer Science and Information Technology

Test Date: 11/02/2017

Test Time: 2:00 PM to 5:00 PM

Subject Name: Computer Science and Information Technology

Section: General Aptitude

1. Saturn is _____ to be seen on a clear night with the naked eye.
   (A) enough bright (C) as enough bright
   (B) bright enough (D) bright as enough
   [Ans. B]
   The word 'enough' as an adverb falts after the adjective so 'bright enough' is the right answer

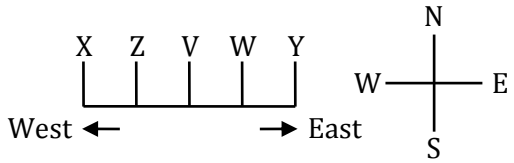
2. A test has twenty questions worth 100 marks in total. There are two types of questions. Multiple choice questions are worth 3 marks each and essay questions are worth 11 marks each. How many multiple choice questions does the exam have?
   (A) 12 (B) 15 (C) 18 (D) 19
   [Ans. B]
   Total marks in the test = 100
   For multiple choice questions = 3 marks
   For essay questions = 11 marks
   Option (A)
   Marks for multiple choice questions = $12 \times 3 = 36$
   Marks for essay type questions = $100 - 36 = 64$
   64 is not divisible by 11
   ∴ Option (A) is not correct.
   Option (B)
   Marks for multiple choice questions = $15 \times 3 = 45$
   Marks for essay type questions = $100 - 45 = \frac{55}{11} = 5$
   Essay type questions are 5 No's
   ∴ Option (B) is correct
   Option(C)
   Marks for multiple choice questions = $18 \times 3 = 54$
   Marks for essay type questions = $-100 - 54 = 46$
   46 is not divisible by 11
   ∴ Option (C) is not correct.
   Option (D)
   Marks for multiple choice questions = $19 \times 3 = 57$
   Marks for essay type questions = $100 - 57 = 43$

46 is not divisible by 11
∴ Option (D) is not correct.

3. There are 3 red socks, 4 green socks and 3 blue socks. You choose 2 socks. The probability that they are of the same colour is
(A) 1/5
(B) 7/30
(C) 1/4
(D) 4/15
[Ans. D]
Red socks = 3
Green socks = 3
Blue socks = 3
∴ The probability that they are of the same colours of pair $= \frac{^3C_2}{^{10}C_2} + \frac{^4C_2}{^{10}C_2} + \frac{^3C_2}{^{10}C_2}$
$= \frac{3}{45} + \frac{6}{45} + \frac{3}{45}$
$= \frac{12}{45} = \frac{4}{15}$

4. Choose the option with words that are not synonyms.
(A) aversion, dislike
(B) luminous, radiant
(C) plunder, loot
(D) yielding, resistant
[Ans. D]
'Yielding' means tending to do where as 'resistant' means opposed to something, so both are not synonyms.

5. There are five building called V, W, X, Y and Z in a row (not necessarily in that order). V is to the West of W, Z is to the East of X and the West of V, W is the West of Y. Which is the building in the middle?
(A) V
(B) W
(C) X
(D) Y
[Ans. A]
From the given data, the following Row is formed



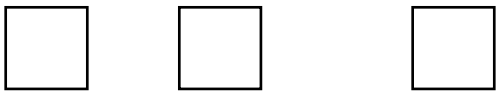
∴ The building 'V' is in the middle

6. There are three boxes. One contains apples, another contains oranges and the last one contains both apples and oranges. All three are known to be incorrectly labelled. If you are permitted to open just one box and then pull out and inspect only one fruit, which box would you open to determine the contents of all three boxes?
(A) The box labelled 'Apples'
(B) The box labelled 'Apples and Oranges'
(C) The box labelled 'Oranges'
(D) Cannot be determined

[Ans. B]

The person who is opening the boxes, he knew that all 3 are marked wrong.

Suppose if three boxes are labelled as below.



(1) Apples (2) Oranges (3) Apples & Oranges

If he inspected from Box (1), picked one fruit, found orange, then he don't know whether Box contains oranges (or) both apples & oranges.

Similarly if he picked one fruit from box(2), found apple then he don't know whether box contain apples (or) both apples & oranges.

But if he picked one fruit from box(3), i.e., labelled as 'apples & oranges', if he found apple then he can decide compulsorily that box (3) contain apples and as he knew all boxes are labeled as incorrect, he can tell box(2) contains both apples & oranges, box(1) contain remaining oranges. So, he should open box labelled 'apples & oranges' to determine contents of all the three boxes.

7. The number of roots or $e^x + 0.5x^2 - 2 = 0$ in the range $[-5, 5]$ is

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

[Ans. C]

$e^x + 0.5\,x^2 - 2 = 0$ in the range$[-5, 5]$

$f(x) = e^x + 0.5\,x^2 - 2$

$f(-5) = 10.50$

$f(-4) = 6.01$

$f(-2) = 0.135$
$f(-1) = -1.13$ } ..... ①

$f(0) = -1$
$f(1) = 1.21$ } ..... ②

$f(2) = 7.38$

As there are 2 sign changes from +ve to − ve and − ve to + ve

Two roots will be there in the range $[-5, 5]$

8. X is a 30 digit number starting with the digit 4 followed by the digit 7. Then the number X^3 will have

(A) 90 digits (C) 92 digits

(B) 91 digits (D) 93 digits

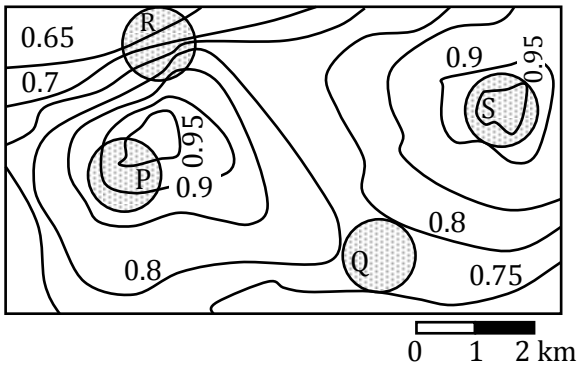
[Ans. A]

$X = (47\ldots)_{30\text{ digits}}$

Suppose $(47)^3 = 2 + 2 + 2$ digits in $(47)^3$

Similarly $(47\ldots)^3_{30\text{ digits}}$ = contains $30 + 30 + 30$ digits = 90 digits

9. An air pressure contour line joins locations in a region having the same atmospheric pressure. The following is an air pressure contour plot of a geographical region. Contour lines are shown at 0.05 bar intervals in this plot.



If the possibility of a thunderstorm is given by how fast air pressure rises or drops over a region. Which of the following regions is most likely to have a thunderstorm?

(A) P
(B) Q
(C) R
(D) S

[Ans. C]

Region	Air pressure difference
P	$0.95 - 0.90 = 0.05$
Q	$0.80 - 0.75 = 0.05$
R	$0.85 - 0.65 = 0.20$
S	$0.95 - 0.90 = 0.05$

In general thunderstorms are occurred in a region where suddenly air pressure changes (i.e.,) sudden rise (or) sudden fall of air pressure. From the given contour map in 'R' Region only more changes in air pressure so, the possibility of a thunderstorm in this region.

$\therefore$ option (C) is correct.

10. "We lived in a culture that denied any merit to literary works, considering them important only when they were handmaidens to something seemingly more urgent-namely ideology. This was a country where all gestures, even the most private, were interpreted in political terms".

The author's belief that ideology is not as important as literature is revealed by the word:

(A) 'culture'
(B) 'seemingly'
(C) 'urgent'
(D) 'political'

[Ans. B]

It appears to be 'B', so the right option is 'B'.

Section: Technical

1. If $f(x) = R\sin\left(\frac{\pi x}{2}\right) + S$. $f'\left(\frac{1}{2}\right) = \sqrt{2}$ and $\int_0^1 f(x)dx = \frac{2R}{\pi}$, then the constants R and S are respectively.

(A) $\frac{2}{\pi}$ and $\frac{16}{\pi}$
(B) $\frac{2}{\pi}$ and 0
(C) $\frac{4}{\pi}$ and 0
(D) $\frac{4}{\pi}$ and $\frac{16}{\pi}$

[Ans. C]

Given that

$f(x) = R\sin\left(\frac{\pi x}{2}\right) + S \ldots\ldots\ldots ①$

$f'\left(\frac{1}{2}\right) = \sqrt{2} \ldots\ldots\ldots ②$

$\int_0^1 f(x)dx = \frac{2R}{\pi} \ldots\ldots\ldots ③$

$f'(x) = \left(\frac{\pi R}{2}\right)\cos\left(\frac{\pi x}{2}\right)$

$f'\left(\frac{1}{2}\right) = \sqrt{2}$

$\Rightarrow \frac{\pi R}{2}\cos\left(\frac{\pi}{4}\right) = \sqrt{2}$

$R = \frac{4}{\pi}$

$\int_0^1 f(x)dx = \frac{2R}{\pi}$

$\Rightarrow \int_0^1 \left[R\sin\left(\frac{\pi x}{2}\right) + S\right]dx = \frac{2R}{\pi}$

$\Rightarrow \int_0^1 \left[\frac{4}{\pi}\sin\frac{\pi x}{2} + S\right]dx = \frac{8}{\pi^2}$

$\Rightarrow -\frac{8}{\pi^2}\left[\cos\left(\frac{\pi x}{2}\right)\right]^1 + S(x)_0^1 = \frac{8}{\pi^2}$

$\Rightarrow S = 0$

2. Let L_1, L_2 be any two context-free languages and R be any regular language. Then which of the following is/are CORRECT?

I. $L_1 \cup L_2$ is context-free
II. $\bar{L}_1$ is context-free
III. $L_1 - R$ is context-free
IV. $L_1 \cap L_2$ is context-free

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

[Ans. B]

L_1, L_2 be two context free languages, R is any Regular language union of two CFL is again a CFL

$\Rightarrow L_1 \cup L_2$ is a CFL

$\Rightarrow L_1 - R$ is also context free
$\therefore$ I and III is correct

3. G is an undirected graph with n vertices and 25 edges such that each vertex of G has degree at least 3. Then the maximum possible value of n is _____.

[Ans. *] Range: 16.0 to 16.0

For any undirected graph, if degree of each vertex is atleast k, then
$k|V| \leq 2|E|$ Where $|V| = n$
$\Rightarrow 3|V| \leq 2(25)$
$\Rightarrow |V| \leq 16.66$
$\Rightarrow |V| \leq 16$ ($\because |V|$ is an integer)
$\therefore$ Maximum possible value of $n = 16$

4. Consider the following tables T1 and T2

T1

P	Q
2	2
3	8
7	3
5	8
6	9
8	5
9	8

T2

R	S
2	2
8	3
3	2
9	7
5	7
7	2

In table T1, P is the primary key and Q is the foreign key referencing R in table T2 with on-delete cascade and on-update cascade. In table T2, R is the primary key and S is the foreign key referencing P in table T1 with on-delete set NULL and on-update cascade. In order to delete record (3, 8) from table T1, the number of additional records that need to be deleted from table T1 is _____

[Ans. *] Range: 0.0 to 0.0

When <3, 8> is deleted, its related tuples in T2 is (8, 3) and 3 is to set null. Hence the number of additional tuples to delete is 0

5. The minimum possible number of states of a deterministic finite automaton that accepts the regular language $L = \{w_1 a w_2 | w_1, w_2 \in \{a, b\}^*, |w_1| = 2, |w_2| \geq 3\}$ is _____

[Ans. *] Range: 8.0 to 8.0

$L = \{w_1 a w_2 | w_1, w_2 \in \{a + b\}^*, |w_1| = 2, |w_2| \geq 3\}$
Let $X \in L$
$\Rightarrow X = w_1\ a\ w_2 \qquad |w_1| = 2$
$|X| \geq 6 \qquad |w_2| = 3$
L has strings of length ≥ 6. So minimum 7 states are required and to make it complete one dead state is required
$\therefore$ Minimum Number of states required to construct DFA for the language L is 8

6. The representation of the value of a 16-bit unsigned integer X in hexadecimal number system is BCA9. The representation of the value of X in octal number system is

(A) 571244
(B) 736251
(C) 571247
(D) 136251

[Ans. D]

Given data is $BCA9_H$

$\underline{1}\,\underline{011}\,\underline{110}\,\underline{010}\,\underline{101}\,\underline{001}_2 = 136251_8$

7. Let p, q, r denote the statements "It is raining", "It is cold" and "It is pleasant", respectively. Then the statement "It is not raining and it is pleasant, and it is not pleasant only if it is raining and it is cold" is represented by

(A) $(\neg p \wedge r) \wedge (\neg r \rightarrow (p \wedge q))$
(B) $(\neg p \wedge r) \wedge ((p \wedge q) \rightarrow \neg r)$
(C) $(\neg p \wedge r) \vee ((p \wedge q) \rightarrow \neg r)$
(D) $(\neg p \wedge r) \vee (r \rightarrow (p \wedge q))$

[Ans. A]

The sentence 'it is not raining and it is pleasant' can be represented as $(\sim p \wedge r)$

The sentence 'it is not pleasant only if it is raining and it is cold can be represented as $\sim r \rightarrow (p \wedge q)$

$\therefore$ The given statement can be represented as $(\sim p \wedge r) \wedge (\sim r \rightarrow (p \wedge q))$

8. Consider socket API on a Linux machine that supports connected UDP sockets. A connected UDP socket is a UDP socket on which connect function has already been called. Which of the following statements is/are CORRECT?

I. A connected UDP socket can be used to communicate with multiple peers simultaneously.
II. A process can successfully call connect function again for an already connected UDP socket.

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

[Ans. B]

Bind () function creates local address.

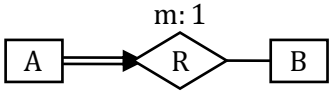
Connect () function is specifying remote address. An unconnected UDP socket is just a Bind () function.

A connected UDP socket is one more step above i.e. connect () function [Just behaves like TCP]

9. An ER model of a database consists of entity types A and B. These are connected by a relationship R which does not have its own attribute. Under which one of the following conditions, can the relational table for R be merged with that of A?

(A) Relationship R is one-to-many and the participation of A in R is total.
(B) Relationship R is one-to-many and the participation of A in R is partial.
(C) Relationship R is many-to-one and the participation of A in R is total.
(D) Relationship R is many-to-one and the participation of A in R is partial.

[Ans. C]



Here the relation R is merged with R.

10. Match the following:

(P) static char var;	(i) Sequence of memory locations to store addresses
(Q) m = malloc (10); m = NULL;	(ii) A variable located in data section of memory
(R) char *ptr[10];	(iii) Request to allocate a CPU register to store data
(S) register int var1;	(iv) A lost memory which cannot be freed

(A) P → ii, Q → iv, R → i, S → iii
(B) P → ii, Q → i, R → iv, S → iii
(C) P → ii, Q → iv, R → iii, S → i
(D) P → iii, Q → iv, R → i, S → ii

[Ans. A]

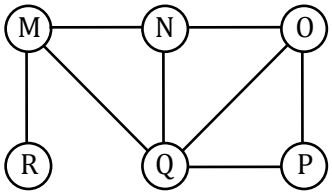
11. Which of the following statements about parser is/are CORRECT?
I. Canonical LR is more powerful than SLR.
II. SLR is more powerful than LALR.
III. SLR is more powerful than Canonical LR.

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

[Ans. A]

CLR is more powerful than SLR and LALR is more powerful than SLR.

12. The Breadth First Search (BFS) algorithm has been implemented using the queue data structure. Which one of the following is a possible order of visiting the nodes in the graph below?



(A) MNOPQR
(B) NQMPOR
(C) QMNROP
(D) POQNMR

[Ans. D]

13. Which of the following is/are shared by all the threads in a process?
I. Program counter
II. Stack
III. Address space
IV. Registers

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

[Ans. B]

Threads of a process share data section, code section and heap, but do not share stack and registers.

14. In a file allocation system, which of the following allocation scheme(s) can be used if no external fragmentation is allowed?

I. Contiguous
II. Linked
III. Indexed

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

[Ans. D]

In contiguous allocation method, external Fragmentation may occur, but in linked and indexed allocation the blocks are allocated in non-contiguous manner. So possibility of external fragmentation is none.

15. Let $P = \begin{bmatrix} 1 & 1 & -1 \\ 2 & -3 & 4 \\ 3 & -2 & 3 \end{bmatrix}$ and $Q = \begin{bmatrix} -1 & -2 & -1 \\ 6 & 12 & 6 \\ 5 & 10 & 5 \end{bmatrix}$ be two matrices

Then the rank of $P + Q$ is _____

[Ans. *] Range: 2.0 to 2.0

$P + Q = \begin{bmatrix} 0 & -1 & -2 \\ 8 & 9 & 10 \\ 8 & 8 & 8 \end{bmatrix}$

$|P + Q| = 0$

$\Rightarrow$ Rank of $(P + Q) < 3$

$(P + Q)$ has 2 linearly independent rows

$\therefore$ Rank of $(P + Q) = 2$

16. Consider the following function implemented in C:

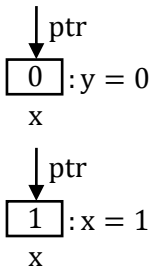
```
void printxy (int x, int y)
{
    int * ptr;
    x = 0;
    ptr = &x;
    y =* ptr;
    * ptr = 1;
    Printf(%d, %d, x, y);
}
```

The output of invoking printxy (1, 1) is

(A) 0, 0
(B) 0, 1
(C) 1, 0
(D) 1, 1

[Ans. C]

print xy (1, 1)



Hence the output will be (1, 0)

17. A circular queue has been implemented using a singly linked list where each node consists of a value and a single pointer pointing to the next node. We maintain exactly two external pointers FRONT and REAR pointing to the front node and the rear node of the queue, respectively. Which of the following statements is/are CORRECT for such a circular queue, so that insertion and deletion operations can be performed in O(1) time?

I. Next pointer of front node points to the rear node.
II. Next pointer of rear node points to the front node.

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

[Ans. B]

It is an extension for the basic single linked list. In circular linked list Instead of storing a Null value in the last node of a single linked list, store the address of the 1st node (root) forms a circular linked list. Using circular linked list it is possible to directly traverse to the first node after reaching the last node and so perform additions and deletions in O(1) time complexity. For that, rear node points to front node but front node doesn't point to rear node.

18. Consider a quadratic equation $x^2 - 13x + 36 = 0$ with coefficients in a base b. The solutions of this equation in the same base b are $x = 5$ and $x = 6$. Then b = _____

[Ans. *] Range: 8.0 to 8.0

Clearly $13 = 1 \times 10 + 3$ and $36 = 3 \times 10 + 6 \Rightarrow \text{baseb} = 10$

The quadratic equation with solutions $x = 5$ and $x = 6$ is $x^2 - 11x + 30 = 0$

According to the given condition, we have $b + 3 = 11$ and $3b + 6 = 30 \Rightarrow b = 8$

19. Consider the following statement about the routing protocols, Routing Information Protocol (RIP) and Open Shortest Path First (OSPF) in an IPv4 network.

I. RIP uses distance vector routing
II. RIP packets are sent using UDP
III. OSPF packets arte sent using TCP
IV. OSPF operation is based on link-state routing

Which of the statements above are CORRECT?

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

[Ans. C]

RIP uses distance vector routing

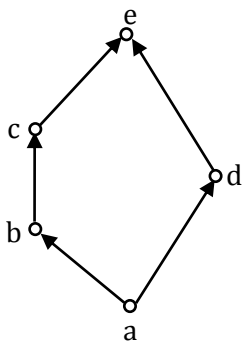
RIP packets are sent using UDP
OSPF doesn't use UDP or TCP and sends directly via IP
OSPF operation is based on LSR

20. The maximum number of IPv4 router addresses that can be listed in the record route (RR) option field of an IPv4 header is _____.

[Ans. *] Range: 9.0 to 9.0

Record Route option in the IP header is used to record the path taken by the Echo Request message and corresponding Echo Reply message (available on IPv4 only). Each hop in the path uses an entry in the Record Route option. If possible, specify a Count that is equal to or greater than the number of hops between the source and destination. The Count must be a minimum of 1 and a maximum of 9.
The maximum number of addresses or names in the host list is 9

21. Consider the set X = {a, b, c, d, e} under the partial ordering
R = {(a, a), (a, b), (a, c), (a, d), (a, e), (b, b), (b, c), (b, e), (c, c), (c, e), (d, d), (d, e), (e, e)}.
The Hasse diagram of the partial order (X, R) is shown below.



The minimum number of ordered pairs that need to be added to R to make (X, R) a lattice is _____

[Ans. *] Range: -0.01 to 0.01

In the given poset, the Join and meet exist for every pair of elements in X.
∴ The poset (X, R) is a lattice. Hence, the minimum number of ordered pairs that need to be added to R to make (X, R) a lattice = 0

22. Given the following binary number in 32-bit (single precision) IEEE–754 format:
00111110011011010000000000000000
The decimal value closest to this floating-point number is

(A) 1.45×10^{1} (C) 2.27×10^{-1}
(B) 1.45×10^{-1} (D) 2.27×10^{1}

[Ans. C]

00 11111 00 110 110 1000 … 0
$S = 0, E = 01111100, M = 11011010 \ldots 0$
Expression value $= (-1)^{S} \times 1.M \times 2^{E-127}$

$$= (-1) \times 1.11011010_2 \times 2^{-3} = 1.85_{10} \times \frac{1}{8}$$
$$= 0.23 = 2.3 \times 10^{-1}$$

23. Match the following according to input (from the left column) to the compiler phase (in the right column) that processes it:

P. Syntax tree	(i) Code generator
Q. Character stream	(ii) Syntax analyzer
R. Intermediate representation	(iii) Semantic analyzer
S. Token stream	(iv) Lexical analyzer

(A) P - ii, Q - iii, R - iv, S - i
(B) P - ii, Q - i, R - iii, S - iv
(C) P - iii, Q - iv, R - i, S - ii
(D) P - i, Q - iv, R - ii, S – iii

[Ans. C]

24. Match the algorithms with their time complexities:

Algorithm	Time complexity
P. Towers of Hanoi with n disks	(i) $\theta(n^2)$
Q. Binary search given n sorted numbers	(ii) $\theta(n \log n)$
R. Heap sort given n numbers at the worst case	(iii) $\theta(2^n)$
S. Addition of two n × n matrices	(iv) $\theta(\log n)$

(A) P - iii, Q - iv, R - i, S - ii
(B) P - iv, Q - iii, R - i, S - ii
(C) P - iii, Q - iv, R - ii, S - i
(D) P - iv, Q - iii, R - ii, S – i

[Ans. C]

Towers of Hanoi with n disks $-O(2n)$
Binary search given n sorted numbers $-O(\log n)$
Heap sort given n numbers at worst case $-O(n \log n)$
Addition of two matrices of size $n \times n - O(n2)$

25. Identify the language generated by the following grammar, where S is the start variable.

$S \rightarrow XY$
$X \rightarrow aX \mid a$
$Y \rightarrow aYb \mid \varepsilon$

(A) $\{a^m b^n \mid m \geq n, n > 0\}$
(B) $\{a^m b^n \mid m \geq n, n \geq 0\}$
(C) $\{a^m b^n \mid m > n, n \geq 0\}$
(D) $\{a^m b^n \mid m > n, n > 0\}$

[Ans. C]

The given grammar with S as start symbol is
$S \rightarrow XY$
$X \rightarrow aX|a$
$Y \rightarrow aYb|\epsilon$
From Non terminal X we can generate any number of a's including a single 'a' and from Y equal number of a's and b's.
Hence $L = \{a^m b^n | m > n, n \geq 0\}$

26. Consider the following C Program

```
#include <stdio.h>
int main()
{
    int m = 10;
    int n, n1;
    n = + + m;
    n1 = m + +;
    n − −;
    − − n1;
    n−= n1;
    printf(%d, n);
    return 0;
}
```

The output of the program is _____

[Ans. *] Range: 0 to 0

1. int m = 10; //m = 10
2. int n, n1;
3. n = + + m; //n = 11
4. n1 = m + +; //n1 = 11, m = 12
5. n − −; //n = 10
6. − − n1; //n1 = 10
7. n−= n1; //n = 0
8. printf(%d, n);

The output will be 0.

27. Consider the C program fragment below which is meant to divide x by y using repeated subtractions. The variables x, y, q and r are all unsigned int.

```
while (r >= y)
{
    r = r − y;
    q = q + 1;
}
```

Which of the following conditions on the variables x, y, q and r before the execution of the fragment will ensure that the loop terminates in a state satisfying the condition x == (y * q + r)?

(A) (q == r) && (r == 0)
(B) (x > 0)&& (r == x) && (y > 0)
(C) (q == 0) && (r == x) && (y > 0)
(D) (q == 0) && (y > 0)

[Ans. C]

For r = = x, y > 0 and q = = 0

we have x = y × q + r

28. Consider the recurrence function

$$T(n) = \begin{cases} 2T(\sqrt{n}) + 1, & n > 2 \\ 2, & 0 < n \leq 2 \end{cases}$$

Then $T(n)$ in terms of θ notation is

(A) $\theta(\log \log n)$
(B) $\theta(\log n)$
(C) $\theta(\sqrt{n})$
(D) $\theta(n)$

[Ans. B]

$T(n) = 2T(\sqrt{n}) + 1 \quad \text{if } n > 2$
$= 2 \qquad\qquad 0 < n \leq 2$

At k^{th} iteration, we have $n^{2^{\frac{1}{k}}} = 2$

$2^k = \log_2 n$

$k = \log_2 \log_2 n$

By substituting 'k' value in $T(n)$, we have

$T(n) = \theta(\log n)$

29. A message is made up entirely of characters from the set X = {P, Q, R, S, T}. The table of probabilities for each of the characters is shown below:

Character	Probability
P	0.22
Q	0.34
R	0.17
S	0.19
T	0.08
Total	1.00

If a message of 100 characters over X is encoded using Huffman coding, then the expected length of the encoded message in bits is _____.

[Ans. *] Range: 225.0 to 225.0

Calculate the Average Number of Bits per Character using Huff. Coding and Multiply with the number of characters present in the Message.

30. The read access times and the hit ratios for different caches in a memory hierarchy are as given below.

Cache	Read access time (in nanoseconds)	Hit ratio
I-cache	2	0.8
D-cache	2	0.9
L2-cache	8	0.9

The read access time of main memory is 90 nanoseconds. Assume that the caches use the referred word-first read policy and the write back policy. Assume that all the caches are direct mapped caches. Assume that the dirty bit is always 0 for all the blocks in the caches. In execution of a program, 60% of memory reads are for instruction fetch and 40% are for memory operand fetch. The average read access time in nanoseconds (up to 2 decimal places) is _____.

[Ans. *] Range: 4.72 to 4.72

Given,

Cache	I-Cache	D-Cache	L_2-Cache	Main Memory
Read Access Time (in ns)	2	2	8	90
Hit Ratio	0.8	0.9	0.9	1.0

And in execution of program 60% of memory reads are for instruction fetch and 40% are for memory operand fetch.

Now, Average instruction fetch time = I-cache access time+ I-cache miss ratio * L_2-cache access time + I-cache miss rate * L_2-cache miss ratio * main memory access time

$= 2 + (1 - 0.8) \times 8 + (1 - 0.8) \times (1 - 0.9) \times 90 = 5.4$ n sec

And average data fetch time = D-cache access time +D-cache miss ratio* L_2-cache access time+ D-cache miss ratio *L_2-cache miss ratio* main memory access time

$2 + (1 - 0.9) \times 8 + (1 - 0.9) \times (1 - 0.9) \times 90 = 3.7$n sec

Therefore, average memory access time = Fraction of instruction fetch * average instruction fetch time + fraction of data fetch * Average data fetch time

$= 0.6 \times 5.4 + 0.4 \times 3.7 = 4.72$ (in n sec)

31. P and Q are considering to apply for a job. The probability that P applies for the job is $\frac{4}{1}$, the probability that P applies for the job given that Q applies for the job is $\frac{2}{1}$, and the probability that Q applies for the job given that P applies for the job is $\frac{3}{1}$. Then the probability that P does not apply for the job given that Q does not apply for the job is

(A) $\frac{4}{5}$ (C) $\frac{7}{8}$

(B) $\frac{5}{6}$ (D) $\frac{11}{12}$

[Ans. A]

Given that, $p(p) = \frac{1}{4} \ldots\ldots\ldots ①$

$p(P|Q) = \frac{1}{2} \ldots\ldots\ldots ②$

$p(P|Q) = \frac{1}{3} \ldots\ldots\ldots ③$

From ②, $\frac{p(p \cap Q)}{p(Q)} = \frac{1}{2} \ldots\ldots\ldots ④$

From ③, $\frac{p(p \cap Q)}{p(P)} = \frac{1}{3} \ldots\ldots\ldots ⑤$

From ① and ⑤, $p(P \cap Q) = \frac{1}{12} \ldots\ldots\ldots ⑥$

From ④ and ⑥, $p(Q) = \frac{1}{6} \ldots\ldots\ldots ⑦$

Required probability $= p(P|Q) = \frac{p(\overline{P} \cap \overline{Q})}{p(\overline{Q})}$

$$= \frac{1 - p(P \cup Q)}{P(\overline{Q})} = \frac{1 - \left\{\frac{1}{4} + \frac{1}{6} - \frac{1}{12}\right\}}{\left(\frac{5}{6}\right)} = \frac{4}{5}$$

32. Consider the following database table named top_scorer.

top_scorer		
player	**country**	**goals**
Klose	Germany	16
Ronaldo	Brazil	15
G Muller	Germany	14
Fontaine	France	13
Pele	Brazil	12
Klinsmann	Germany	11
Kocsis	Hungary	11
Batistuta	Argentina	10
Cubillas	Peru	10
Lato	Poland	10
Lineker	England	10
T Muller	Germany	10
Rahn	Germany	10

Consider the following SQL query:

```
SELECT ta.player FROM top_scorer AS ta
WHERE ta.goals > ALL (SELECT tb.goals)
      FROM top_scorer AS tb
      WHERE tb.country = 'Spain')
AND ta.goals> ANY (SELECT tc.goals
      FROM top_scorer AS tc
      WEHRE tc.country = 'Germany')
```

The number of tuples returned by the above SQL query is _____.

[Ans. *] Range: 7.0 to 7.0

The output of the query is ta.player

Klose
Ronaldo
G muller
Fontaine
Pele
Klismann
Kocsis

33. In a B^+ tree, if the search-key value is 8 bytes long, the block size is 512 bytes and the block pointer size is 2 bytes, then the maximum order of the B^+ tree is _____.

[Ans. *] Range: 52.0 to 52.0

Key =8, Block size = 512, Block pointer = 2 bytes, the order of B^+ tree is maximum number of block pointers in it. (Let 'n')

$n * 2 + (n - 1)8 \leq 512$

$2n + 8n - 8 \leq 512$

$10n \leq 520$

$n \leq 52$

34. If the ordinary generating function of a sequence $\{a_n\}_{n=0}^{\infty}$ is $\frac{1+Z}{(1-Z)^3}$, then $a_3 - a_0$ is equal to _____

[Ans. *] Range: 15.0 to 15.0

Let $\frac{1+Z}{(1-Z)^3} = a_0 + a_1Z + a_2Z^2 + a_3Z^3 + \cdots \infty \ldots\ldots\ldots ①$

$\frac{1+Z}{(1-Z)^3} = (1+Z)(1-Z)^{-3}$

$= (1+Z)(1+3Z+6Z^2+10Z^3+\cdots\infty)$

Using binomial theorem

$= 1+4Z+9Z^2+16Z^3+\cdots\infty \ldots\ldots\ldots ②$

From ① and ②, $a_0 = 1$ and $a_3 = 16$

$\therefore a_3 - a_0 = 15$

35. Consider the following languages.

$L_1 = \{a^p \mid p \text{ is a prime number}\}$

$L_2 = \{a^n b^m c^{2m} \mid n \geq 0, m \geq 0\}$

$L_3 = \{a^n b^n c^{2n} \mid n \geq 0\}$

$L_4 = \{a^n b^n \mid n \geq 1\}$

Which of the following are CORRECT?

I. L_1 is context-free but not regular
II. L_2 is not context-free.
III. L_3 is not context-free but recursive
IV. L_4 is deterministic context-free

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

[Ans. D]

$L_1 = \{a^p \mid p \text{ is Prime}\}$- CSL

$L_2 = \{a^n b^m c^{2m} \mid m \geq 0, n \geq 0\}$- CFL

$L_3 = \{a^n b^n c^{2n} \mid n \geq 0\}$- CSL → Recursive

$L_4 = \{a^n b^n \mid n \geq 1\}$- DCFL, CFL

III. L_3 is Not context free but Recursive - correct
Since every CSL in recursive

IV. L_4 is DCFL - correct
L_4 is accepted by DPDA
$\therefore$ III and IV is correct

36. A system shares 9 tape drives. The current allocation and maximum requirement of tape drives for three processes are shown below:

Process	Current Allocation	Maximum Requirement
P1	3	7
P2	1	6
P3	3	5

Which of the following best describes current state of the system?

(A) Safe, Deadlocked
(B) Safe, Not Deadlocked
(C) Not Safe, Deadlocked
(D) Not Safe, Not Deadlocked

[Ans. B]

Process	Current Allocation	Maximum Requirement	Current Need	Current Available
P1	3	7	4	$9-7=2$
P2	1	6	5	
P3	3	5	2	
	Total = 7			

With 2 available tape drives, current need of P3 can be fulfilled, so P3 can execute completely then after that P3 will release its allocated resources. Which will make total available drives to 5. After that P1 and P2 processes can finish in any order. All processes can complete, hence safe state and no deadlock.

37. Consider a machine with a byte addressable main memory of 2^{32} bytes divided into blocks of size 32 bytes. Assume that a direct mapped cache having 512 cache lines is used with this machine. The size of the tag field in bits is _____.

[Ans. *] Range: 18.0 to 18.0

Main Memory Size $= 2^{32}$ Bytes

Block size $= 2^5$ Bytes

Number of blocks in Cache $= 2^9$

Tag 18	Block offset 9	Word offset 5

← Physical Address (32) →

Block offset size $= \log_2 512 = 9$

Word offset size $= \log_2 32 = 5$

38. Consider the set of processes with arrival time (in milliseconds). CPU burst time (in milliseconds), and priority (0 is the highest priority) shown below. None of the processes have I/O burst time.

Process	Arrival Time	Burst Time	Priority
P_1	0	11	2
P_2	5	28	0
P_3	12	2	3
P_4	2	10	1
P_5	9	16	4

The average waiting time (in milliseconds) of all the processes using preemptive priority scheduling algorithm is _____.

[Ans. *] Range: 29.0 to 29.0

Gantt Chart:

P_1	P_4	P_2	P_4	P_1	P_3	p_5

0 2 5 33 40 49 51 67

Process	Waiting Time
P_1	38
P_2	0
P_3	37
P_4	28
P_5	42
	Total = 145

Average waiting time $= \frac{145}{5} = 29$

39. The next state table of a 2-bit saturating up-counter is given below.

Q_1	Q_0	Q_1^+	Q_0^+
0	0	0	1
0	1	1	0
1	0	1	1
1	1	1	1

The counter is built as a synchronous sequential circuit using T flip-flops. The expression for T1 and T0 are

(A) $T_1 = Q_1Q_0, T_0 = \bar{Q}_1\bar{Q}_0$
(B) $T_1 = \bar{Q}_1Q_0, T_0 = \bar{Q}_1 + \bar{Q}_0$
(C) $T_1 = Q_1 + Q_0, T_0 = \bar{Q}_1 + \bar{Q}_0$
(D) $T_1 = \bar{Q}_1Q_0, T_0 = Q_1 + Q_0$

[Ans. B]

Q_1	Q_0	T_1	T_0
0	0	0	1
0	1	1	1
1	0	0	1
1	1	0	0
1	1	→ Saturated	

$T_1 = \bar{Q}_1\, Q_0$
$T_0 = \bar{Q}_1 + \bar{Q}_0$

40. If w, x, y, z are Boolean variables, then which one of the following is INCORRECT?

(A) $wx + w(x + y) + x(x + y) = x + wy$
(B) $\overline{w\bar{x}(y + \bar{z})} + \bar{w}x = \bar{w} + x + \bar{y}z$
(C) $(w\bar{x}(y + x\bar{z}) + \bar{w}\bar{x})y = x\bar{y}$
(D) $(w + y)(wxy + wyz) = wxy + wyz$

[Ans. C]

Option A:

$wx + wx + wy + x + xy = x + wy$
$wx + x + xy + wy = x + wy$
$x + wy = x + wy$
True

Option B:

$\overline{w\bar{x}(y + \bar{z})} + \bar{w}x = \bar{w} + x + \bar{y}z$
$\overline{w\bar{x}y + w\bar{x}\bar{z}} + \bar{w}x = \bar{w} + x + \bar{y}z$
$(\bar{w} + x + \bar{y}).(\bar{w} + x + z) + \bar{w}x = \bar{w} + x + \bar{y}z$
$\bar{w} + \bar{w}x + \bar{w}z + \bar{w}x + x + xz + \bar{w}\bar{y} + x\bar{y} + \bar{y}z = \bar{w} + x.\bar{y}z$

$\bar{w} + x + \bar{y}z = \bar{w} + x + \bar{y}z$
True
Option C:
$(w\bar{x}(y + x\bar{z}) + \bar{w}\bar{x})y = x\bar{y}$
$w\bar{x}y + \bar{w}\bar{x}y = x\bar{y}$
$\bar{x}y = x\bar{y}$
False
Option D:
$(w + y).(wxy + wyz) = wxy + wyz$
$wxy + wyz + wxy + wyz = wxy + wyz$
$\therefore wxy + wyz = wxy + wyz$
True

41. Consider the following C function.

```
int fun(int n)
{
    int i, j;
    for (i = 1; i <= n; i + +)
    {
        for (j = 1; j < n; j+= i)
        {
            printf("%d %d", i, j);
        }
    }
}
```

Time complexity of fun in terms of θ notation is

(A) $\theta\left(n\sqrt{n}\right)$
(B) $\theta(n^2)$
(C) $\theta(n \log n)$
(D) $\theta(n^2 \log n)$

[Ans. C]

$$\text{Running time} = n + \frac{n+1}{2} + \frac{n+2}{3} + \frac{n+3}{4} + \cdots \frac{n+(n-1)}{n}$$
$$= n\left[1 + \frac{1}{2} + \frac{1}{3} + \cdots + \frac{1}{n}\right] + \left[\frac{1}{2} + \frac{2}{3} + \frac{3}{4} + \cdots + \frac{n-1}{n}\right]$$
$$= \theta(n \log n)$$

42. Consider a binary code that consists of only four valid code words as given below:
00000, 01011, 10101, 11110
Let the minimum Humming distance of the code be p and the maximum number of erroneous bits that can be corrected by the code be q. Then the values of p and q are

(A) $p = 3$ and $q = 1$
(B) $p = 3$ and $q = 2$
(C) $p = 4$ and $q = 1$
(D) $p = 4$ and $q = 2$

[Ans. A]

The number of bit positions in which two code words differ is called Hamming Distance.

00000	00000	00000	01011	01011	10101
+01011	+10101	+11110	+10101	+11110	+11110
3	3	4	4	3	3

So minimum distance = 3 ⇐ p

To connect d errors, you need a distance 2d + 1 code

So 3 = 2d +1

Hence d = 1 ⇐ q

p = 3, q = 1

43. Consider two hosts X and Y, connected by a single direct link of rate 106 bits/sec. The distance between the two hosts is 10,000 km and the propagation speed along the link is 2×10^8 m/sec. Host X send a file of 50,000 bytes as one large message to host Y continuously. Let the transmission and propagation delays be p milliseconds and q milliseconds, respectively. Then the values of p and q are

(A) p=50 and q=100
(B) p=50 and q=400
(C) p=100 and q=50
(D) p=400 and q=50

[Ans. D]

Given:

$B = 10^6$ bps

Distance = 10000 km

$TP = 2 \times 10^8$ m/s

L = 50000 B

$$p = T_x = \frac{L}{B} = \frac{50000 \times 8}{100 \times 10^4} = \frac{4}{10} \times \frac{10^3}{10^3} = \frac{4000}{10} = 400 \text{ msec}$$

$$q = \frac{d}{v} = \frac{10000 \times 10^3}{2 \times 10^8} = \frac{1}{20} = \frac{1}{20} \times \frac{10^3}{10^3} = \frac{1000}{20} \text{ ms} = 50 \text{ ms}$$

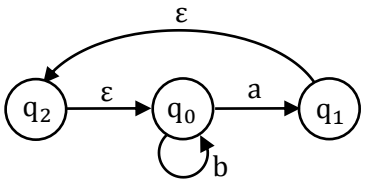
44. Let δ denote the transition function and $\hat{\delta}$ denote the extended transition function of the ε-NFA whose transition table is give below:

δ	ε	a	b
→ q_0	$\{q_2\}$	$\{q_1\}$	$\{q_0\}$
q_1	$\{q_2\}$	$\{q_2\}$	$\{q_3\}$
q_2	$\{q_0\}$	ϕ	ϕ
q_3	ϕ	ϕ	$\{q_2\}$

The $\hat{\delta}(q_2, aba)$ is

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

[Ans. C]



45. If the characteristic polynomial of a 3×3 matrix M over R(the set of real numbers) is $\lambda^3 - 4\lambda^2 + a\lambda + 30$. $a \in R$, and one eigenvalue of M is 2, then the largest among the absolute values of the eigenvalues of M is _____.

[Ans. *] Range: 5.0 to 5.0

The characteristic equation of M is

$\lambda^3 - 4\lambda^2 + a\lambda + 30 = 0 \ldots\ldots\ldots (1)$

Substituting $\lambda = 2$ in (1), we get $a = -11$

Now, the characteristic equation is

$\Rightarrow (\lambda - 2)(\lambda^2 - 2\lambda - 15) = 0$

$\Rightarrow \lambda = 2, -3, 5$

$\therefore$ The largest among the absolute values of the eigen values of $M = 5$

46. Consider the following expression grammar G:

$E \rightarrow E - T \mid T$

$T \rightarrow T + F \mid F$

$F \rightarrow (E) \mid id$

Which of the following grammars is not left recursive, but is equivalent to G?

(A) $E \rightarrow E - T|T$
$T \rightarrow T + F|F$
$F \rightarrow (E)|id$

(B) $E \rightarrow TE'$
$E' \rightarrow -TE'|\varepsilon$
$T \rightarrow T + F|F$
$F \rightarrow (E)|id$

(C) $E \rightarrow TX$
$X \rightarrow -TX|\varepsilon$
$T \rightarrow FY$
$Y \rightarrow +FY|\varepsilon$
$F \rightarrow (E)|id$

(D) $E \rightarrow TX|(TX)$
$X \rightarrow -TX|+TX|\varepsilon$
$T \rightarrow id$

[Ans. C]

The production of the form $A \rightarrow A\alpha/\beta$ is left recursive, and can be eliminated by replacing with

$A \rightarrow \beta A^1$

$A^1 \rightarrow \alpha A^1/\varepsilon$

47. Given $f(w, x, y, z) = \sum_m(0, 1, 2, 3, 7, 8, 10) + \sum_d(5, 6, 11, 15)$, where d represents the don't-care condition in Karnaugh maps. Which of the following is a minimum product-of-sums (POS) form of f(w, x, y, z)?

(A) $f = (\bar{w} + \bar{z})(\bar{x} + z)$
(B) $f = (\bar{w} + z)(x + z)$
(C) $f = (w + z)(\bar{x} + z)$
(D) $f = (w + \bar{z})(\bar{x} + z)$

[Ans. A]

f wx \ yz	00	01	11	10
00	1	1	1	1
01	0	×	1	×
11	0	0	×	10
10	1	0	×	1

$(\bar{x} + z)(\bar{w} + z)$

48. Consider the following snippet of a C program. Assume that swap(&x, &y) exchanges the contents of x and y.

```
int main ( )
{
    int array[ ] = {3, 5, 1, 4, 6, 2};
    int done = 0;
    int i;
    while (done == 0)
    {
        done = 1;
        for(i = 0; i ≤ 4; i + +)
        {
            if (array [i] < array [i + 1])
            {
                swap (&array[i], &array[i + 1]);
                done = 0;
            }
        }
        for (i = 5; i ≥ 1; i − −)
        {
            if (array[i] > array[i− 1])
            {
                swap(&array[i], &array[i− 1];
                done  = 0;
            }
        }
    }
    printf("%d", array[3]);
}
```

The output of the program is _____.

[Ans. *] Range: 3.0 to 3.0

After performing while loop, the content in array[3] is '3'.

0	1	2	3	4	5
3	5	1	4	6	2
5	3	4	6	2	1
6	5	3	4		
6	5	4	3		

49. Two transactions T_1 and T_2 are given as

$T_1: r_1(X)w_1(X)r_1(Y)w_1(Y)$

$T_2: r_2(Y)w_2(Y)r_2(Z)w_2(Z)$

where $r_i(V)$ denotes a read operation by transaction T_i on a variable V and $w_i(V)$ denotes a write operation by transaction T_i on a variable V. The total number of conflict serializable schedules that can be formed by T_1 and T_2 is _____.

[Ans. *] Range: 54.0 to 54.0

There is only one conflict serializable schedule as $T_1 \rightarrow T_2$, because last operation of T_1 and first operation of T_2 conflicts each other.

Number of schedules that are conflict serializable to $T_2 \rightarrow T_1$ is 53.

Proof: The operations of T_1 is $\_R_1(x)\_W_1(x)\_R_1(y)\_W_1(y)$

The first operation of T_2 that conflicts with operation of T_1 is $W_2(y)$ but not $R_2(z), W_2(z)$.

The number of places where $W_2(y)$ can appear is

Case 1: $\underline{W_2(y)}\ R_1(x)\ W_1(x)R_1(y)W_1(y)$

Case 2: $R_1(x)\ \underline{W_2(y)}\ W_1(x)R_1(y)W_1(y)$

Case 3: $R_1(x)W_1(x)\underline{W_2(y)}\ R_1(y)\ W1(y)$

Case 1: The number of positions that $R_2(z)W_2(z)$ can come before $W_2(y)$is ${}^5C_1 + {}^5C_2 = 15$ (either both can take same space or two different spaces).

$R_2(y)$ can come before $W_2(y)$ therefore one position, therefore total possible schedules are $= 15 \times 1$

$= 15$

Case 2: The number of positions that $R_2(z)W_2(z)$ can come before $W_2(y)$ is ${}^4C_1 + {}^4C_2 = 10$

For each of these 10 positions $R_2(y)$ can take 2 positions before $W_2(y)$ therefore total possible schedules are $10 \times 2 = 20$

Case 3: The number of positions that $R_2(z)W_2(z)$ can come before $W_2(y)$ is ${}^3C_1 + {}^3C_2 = 6$

For each of these 6 positions $R_2(y)$ can take 3 positions before $W_2(y)$ therefore total possible schedules are $6 \times 3 = 18$

The total conflict serializable schedules as $T_2 \rightarrow T_1 = 15 + 20 + 18 = 53$

$\therefore$ Total conflict serializable schedules $= 1 + 53 = 54$

50. Consider the following C Program.

```
# include<stdio.h>
# include<string.h>
int main( )
{
    char * c = "GATECSIT2017";
    char * p = c;
    printf("%d", (int)strlen (c + 2[p] − 6[p] − 1));
    return 0;
}
```

The output of the program is ____.

[Ans. *] Range: 2.0 to 2.0

Strlen function computes number of non-zero characters.

So it returns 2.

51. If a random variable X has a Poisson distribution with mean 5, then the expectation $E[(X + 2)^2]$ equals _____.

[Ans. *] Range: 54.0 to 54.0

For poisson distribution,

$E(X) = \text{Mean} = \lambda = 5$

$E(X^2) = \lambda^2 + \lambda$

Now,

$E[(X+2)^2] = E(X^2 + 4X + 4)$

$= E(X^2) + 4E(X) + 4$

$= [(\lambda^2 + \lambda) + 4\lambda + 4]$, where $\lambda = 5$

$= 54$

52. The pre-order traversal of a binary search tree is given by 12, 8, 6, 2, 7, 9, 10, 16, 15, 19, 17, 20. Then the post-order traversal of this tree is:

(A) 2, 6, 7, 8 , 9 ,10, 12, 15, 16 , 17 ,19 ,20

(B) 2, 7, 6, 10, 9, 8, 15, 17, 20, 19, 16, 12

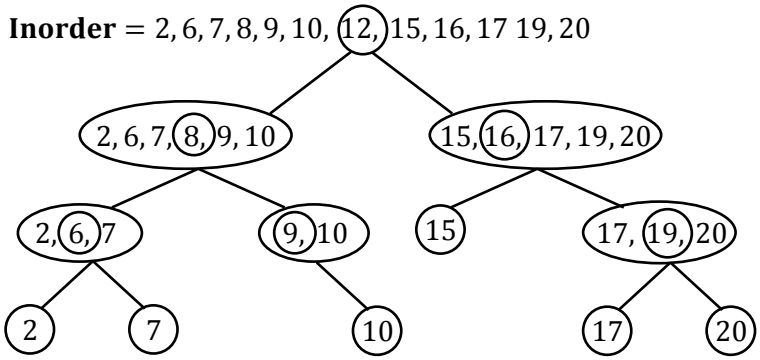
(C) 7, 2, 6, 8, 9, 10, 20, 17, 19, 15, 16, 12

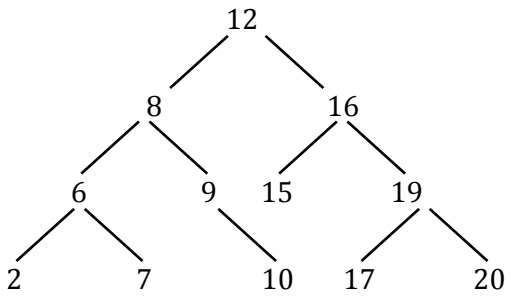
(D) 7, 6, 2, 10, 9, 8, 15, 16, 17, 20, 19, 12

[Ans. B]

Preorder = 12, 8, 6, 2, 7, 9, 10, 16, 15, 19, 17, 20

Inorder = 2, 6, 7, 8, 9, 10, 12, 15, 16, 17 19, 20





= 2, 7, 6, 10, 9, 8, 15, 17, 20, 19, 16, 12

53. Let L(R) be the language represented by regular expression R. Let L(G) be the language generated by a context free grammar G. Let L(M) be the language accepted by a Turing machine M.

Which of the following decision problems are undecidable?

I. Given a regular expression R and a string w, is $w \in L(R)$?

II. Given a context-free grammar G, is $L(G) = \phi$?

III. Given a context-free grammar G, is $L(G) = \Sigma^*$ for some alphabet Σ?

IV. Given a Turing machine M and a string w, is $w \in L(M)$?

(A) I and IV only

(B) II and III only

(C) II, III and IV only

(D) III and IV only

[Ans. D]

L(R) is a Regular language

L(G) is a CFL

L(M) is a REL

R - Regular expression

G - CFG

M - Turing machine

(i) Is $w \in L(R)$? is decidable since membership property is trivial for Regular language

(ii) Is $L(G) = \phi$? is also Decidable, emptyness of CFG is decidable

(iii) Universalness of CFG is undecidable i.e is $L(G) = \Sigma^*$! is undecidable

(iv) Membership property of REL is undecidable

$\therefore$ Is $w \in L(M)$? is undecidable

$\therefore$ (iii) and (iv) is undecidable

54. For any discrete random variable X, with probability mass function

$P(X = j) = p_j, p_j \geq 0, j \in \{0 \dots, N\}$, and $\sum_{j=0}^{N} p_j = 1$, define the polynomial function

$g_x(z) = \sum_{j=0}^{N} p_j z^j$.

For a certain discrete random variable Y, there exists a scalar $\beta \in [0, 1]$ such that $g_y(z) = (1 - \beta + \beta z)^n$. The expectation of Y is

(A) $N\beta(1 - \beta)$

(B) $N\beta$

(C) $N(1 - \beta)$

(D) Not expressible in terms of N and β alone

[Ans. B]

The cumulants generations function

$= K_Y(Z) = \log_e g_y(Z)$

$= \log_e(1 - \beta + \beta z)^N$

$= N.\log(1 - \beta + \beta z)$

$E(Y) = K_1 = \left[\frac{d}{dz}\{K_Y(Z)\}\right]_{z=1}$

$\Rightarrow E(Y) = \left[\frac{N\beta}{1 - \beta + \beta Z}\right]_{z=1}$

$= N\beta$

55. In a two-level cache system, the access times of L_1 and L_2 caches are 1 and 8 clock cycles, respectively. The miss penalty from the L_2 cache to main memory is 18 clock cycles. The miss rate of L_1 cache is twice that of L_2. The average memory access time (AMAT) of this cache system is 2 cycles. The miss rates of L_1 and L_2 respectively are:

(A) 0.111 and 0.056

(B) 0.056 and 0.111

(C) 0.0892 and 0.1784

(D) 0.1784 and 0.0892

[Ans. A]

Hit time $L_1 = 1$ cycle

Hit time $L_2 = 8$ cycle

Miss penalty $L_2 = 18$ cycle

Tavg = 2 ns

Miss rate $L_1 = x$

Miss rate $L_1 = 2x$

Formula:

- Tavg = Hit time L_1 + (Miss rate L_1 × Miss penality L_1)
- Miss penality L_1 = Hit time L_2 + (Miss rate L_2 × Miss penality L_2)
- Substitute the above data and verifying with respect to the given options.
- In this context after substitute the option (A). Data, Tavg becomes 2ns