GATE

Subject : CS 2013 - SOLUTIONS

TECHNICAL SECTION (Q. NO. 1 – 25) 1 MARKS

1. $x \oplus y = x^2 + y^2$

$y \oplus x = y^2 + x^2$

$\therefore \quad x \oplus y = y \oplus x$

Hence $\oplus$ is commutative

Let z be such that

$(x \oplus y) \oplus z = x \oplus (y \oplus z)$

LHS $= (x \oplus y) \oplus z$

$= (x^2 + y^2) \oplus z$

$= (x^2 + y^2)^2 + z^2$

RHS $= x \oplus (y \oplus z)$

$= x \oplus (y^2 + z^2)$

$= x^2 + (y^2 + z^2)^2$

LHS $\neq$ RHS

Hence $\oplus$ is not associative

$\therefore$ (A) is the answer

2. For a poisson distribution, probability is defined as

$$P(x = r) = \frac{e^{-m}m^r}{r!}$$

where m is the mean of the distribution. Given that mean = 3, we have to find the probability of fewer than 3 cars

$\therefore$ P(C < 3) = P(C = 0) + P(C = 1) + P P(C = 2)

$$= \frac{e^{-3}(3)^0}{0!} + \frac{e^{-3}(3)^1}{1!} + \frac{e^{-3}(3)^2}{2!}$$

$= e^{-3}\left[1 + 3 + \frac{9}{2}\right]$

$= \frac{17}{2}e^{-3}$

$= 17/(2e^3)$

$\therefore$ (C) is the answer

3. For a determinant,

(i) Applying any row or coloummn transformation does not change the value of the determinant.

(ii) If you interchange any two rows or any two columns, the sign of the determinant changes i.e. it gets multiplied by (–1)

$$A = \begin{vmatrix} 1 & x & x^2 \\ 1 & y & y^2 \\ 1 & z & z^2 \end{vmatrix}$$

If we apply $C_2 \rightarrow C_2 + C_1$ and $C_3 \rightarrow C_3 + C_1$ to A,

we get option (B)

If we apply $R_1 \rightarrow R_1 - R_2$ and $R_2 \rightarrow R_2 - R_3$ to A,

we get option (C)

If we apply $R_1 \rightarrow R_1 + R_2$ and $R_2 \rightarrow R_2 + R_3$ to A,

We get option (D)

We cannot obtain (A) in any way from the given determinant

$\therefore$ (A) is the answer.

4. The range of n – bit number in 2's complement form is

-2^{n-1} to $+2^{n-1} - 1$

$\therefore$ for n = 8, smallest number is $-2^7 = -128$

(B) is the answer

5. The circuit functions only when V = 1. Also the priorites are given to inputs by making use of 'X' i.e. don't care conditions.

$\therefore$ D_0 has highest priority followed by D_1, D_2 and D_3. And since we can see that number of outputs are less than the number of inputs, it is an encoder.

$\therefore$ (A) is the answer.

6. When elements are sorted using selection sort, it finds the maximum element and swaps it with the last unsorted element. Hence, the maximum number of swaps even in worst case is O(n).

   $\therefore$ (B) is the answer.

7. To insert an element into binary search tree of n nodes, we require time of O(h) where 'h' is the height of the tree.

   But in the worst case, h is (n – 1) for either left-skewed or right-skewed BSTs.

   $\therefore h_{max} = n - 1$

   $\therefore$ Time complexity = O(n – 1) = O(n)

   (C) is the answer

8. $L_1 = \phi$

   $L_2 = \{a\}$

   Let $L = L_1 L_2^* \cup L_1^*$

   $= \phi.a^* \cup \phi^*$

   $= \phi \cup \in$

   $\therefore L = \{\in\}$

   For a regular expression R,

   (i) $\phi R = \phi$

   (ii) $\phi^* = \in$

   (iii) $\in^* = \in$

   (A) is the answer

9. Let the grammar G with given conditions be G

   To derive a string w using G

   $A \rightarrow aX$

   $\rightarrow abY$

   $\rightarrow abcd$

   $\therefore |w| = 4$ # reductions = 3 i.e. (4 – 1)

   $\therefore$ For string of length 'n' we will need (n – 1) reduce moves

   $\therefore$ (B) is the answer

10. The given algorithm is equivalent to Round Robin algorithm with quantum time as T. Hence a process will get its turn again when every other process has executed for T time units.

    (B) is the answer.

11. We know that XML is used to represent information. Only one option matches

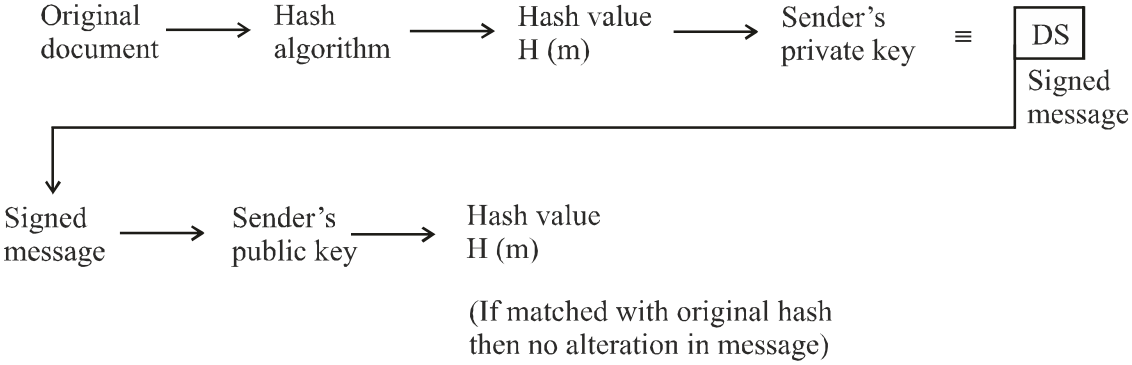
∴ (C) is the answer.

12. There are two important transport layer protocols – TCP and UDP. TCP is connection oriented whereas UDP is connection less.

For real time multimedia, in time delivery of message is more important than correctness. In such cases, UDP is used. File transfer and email, require connection to be established and also correctness is an important factor. Hence, we use TCP whereas DNS uses UDP.

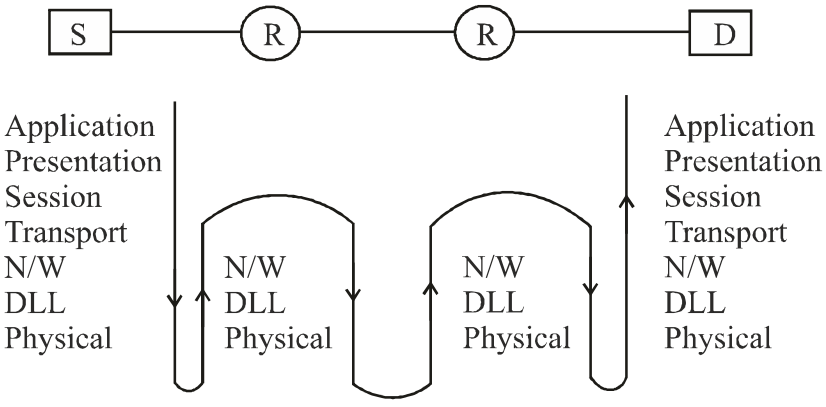
∴ (C) is the answer.

13. Digital signature is based on public key assymmetric cryptography.



∴ (D) is the answer.

14.



i.e. for every router, it enters the data link layer twice

∴ from S to D

Network layer = 4 times

Data link layer = 6 times

∴ (C) is the answer

15. An index is said to be clustered if it is on non key and ordered i.e. the physical records on the disk are ordered in the same manner as the index order.

    (C) is the answer.

16. (A) X : P(a) P(b) P(c) a = b = c = 1 initially

    Y : P(b) P(c) P(d)

    z : P(c) P(d) P(a)

    It has circular wait and also the process get deadlocked when P( ) operation is performed on a, b, and c simultaneously in X, Y and Z.

    (B) X : P(b) P(a) P(c)

    Y : P(b) P(c) P(d)

    Z : P(a) P(c) P(d)

    Here z will get executed when simultaneous execution is performed. Hence there is no deadlock as atleast one of the processes is getting executed.

    Options (C) and (D) also cause deadlock

    $\therefore$ (B) is the answer

17. 1 is true

    2 is false as Turing recognizable languages are REL and they are not closed under complementation.

    3 is true. Turing decidable languages are recursive 4 is true.

    $\therefore$ (C) is the answer

18. 1 is true. We can run either BFS or DFS on the graph to find a cycle.

    2 is true because every P problem is in NP as P is a subset of NP.

    3 is true as NP Complete problems are in NP as well as NP-Hard and the definition of NP problems itself says that it can be solved by a Non-deterministic Turing Machine in polynomial time.

    $\therefore$ (A) is answer.

19. The complexity Bellman-ford algorithm is O(VE) where V is the number of vertices and E is the number of edges.

    For a complete graph,

    $E = O(V^2)$

    $\therefore$ Complexity of Bellman-ford becomes $O(V^3)$

    (C) is the answer

20. # sets in cache = v

lines in each set = k

So main memory block j, according to set associative mapping will be mapped to the set (j mod v)

And since memory is k-way set associative, the cache lines will be (j mod v) * k to (j mod v) * k + (k – 1)

(A) is the answer

21. (A) is true as $x \odot y = xy + \overline{x}\,\overline{y}$

(B) $x \oplus \overline{y} = xy + \overline{x}\,\overline{y} = x \odot y$ $\therefore$ true

(C) $\overline{x} \oplus y = xy + \overline{x}\,\overline{y} = x \odot y$ $\therefore$ true

(D) $\overline{x} \oplus \overline{y} = \overline{x}y + x\,\overline{y} = x \oplus y$ $\therefore$ false

Hence (D) is the answer

22. (A) f(3) = 2

LHL = $\lim\limits_{x \to 3^-} f(x) = \lim\limits_{x \to 3^-} x - 1 = 2$

RHL = $\lim\limits_{x \to 3^+} f(x) = \lim\limits_{x \to 3^+} \dfrac{x+3}{3} = 2$

$\therefore$ LHL = RHL = f(3)

Hence the function f(x) is continuous at x = 3. Also, we do not need to check rest of the options.

(A) is the answer

23. Trapezoidal Rule :

$$\int_a^b f(x)dx = \frac{h}{2}\,[(y_0 + y_n) + 2(y_1 + y_2 + y_3 + ... + y_{n-1})$$

where $h = \dfrac{b-a}{n}$. In the given problem, n = 10

$\therefore$ $h = \dfrac{3-0}{10} = 0.3$

$$\int_0^3 f(x) = \frac{0.3}{2}[(0+9) + 2(0.09 + 0.36 + 0.81 + 1.44 + 2.25 + 3.24 + 4.41 + 5.76 + 7.29 + 9)]$$

$$= \frac{0.3}{2}[9 + 2(25.65)]$$

$= \frac{0.3}{2}$ [9 + 51.3]

= 9.045

$\therefore$ (D) is the answer

24. There are eight vertices. From 8 vertices, can select 3 in ${}^{8}C_{3}$ ways to form a cycle of length 3. Also probability that there is an edge between two vertices is 1/2.

So expected number of enordered cycles of length 3 = ${}^{8}C_{3} \times \left(\frac{1}{2}\right)^{3} = 7$

$\therefore$ (C) is the answer

25. For an undirected graph,

(i) Sum of degrees of all vertices is twice the number of edges. Hence, it is always even.

(ii) Number of vertices of odd degree is even in number (as sum of degrees of all vertices is even)

$\therefore$ Both statements P and Q are true.

(C) is the answer.

TECHNICAL SECTION (Q. NO. 26 – 55) 2 MARKS

26. Given a graph G, its line graph L(G) is a graph such that

(i) each vertex of L(G) represents an edge of G

(ii) two verices of L(G) are adjacent if and only if their corresponding edges share a common endpoint (i.e. are incident) in G.

Using the above properties of a line graph, only P is true

$\therefore$ (A) is the answer.

27. Statement : “None of my freinds are perfect”

Let F(x) : x is my friend

P(x) : x is perfect

(A) There exist some friends who are not perfect

(B) There exist some people who are not my friends and are perfect.

(C) There exist some people who are not my friends and are not perfect.

(D) There does not exist any person who is my friend and perfect.

$\therefore$ (D) is the answer.

28. In instruction and operand fetch, value of PC is not stored anywhere else.

Also in conditional brach, only PC value is changed and we don't need to store the current value of PC.

But in interrupt handling, we need to store the current value of PC to memory so that it can be retained after completion of interrupt when the control is transferred back to the main program where it can continue its execution right from the point where inturrput had occured.

$\therefore$ (D) is the answer.

29. Data in 1 sector = 512 B

Size of line 42797 KB

$\therefore$ No. of sectors accomodated by the file

$$= \frac{42797 \times 1024B}{512B}$$

= 85594 sectors

Also each cylinders has 64 sectors

$$\therefore \text{No of cylinders required} = \frac{85594}{64}$$

$$= 1337.40625$$

These cylinders are distributed among 16 surfaces

$$\therefore \text{One surface will have} = \frac{1337.40625}{16}$$

$$= 83.588 \text{ cylinders}$$

We will need 84 cylinders to store the data as one cylinder will be needed to accomodate the left over data i.e. 0.588 cylinder.

$\therefore$ Cylinder number of last sector = 1200 + 84

= 1284

(D) is the answer.

30. For n elements, heap sort takes O(n logn) time

$\therefore$ for k elements $\rightarrow$ O(k log k) time

$\therefore$ x elements $\rightarrow$ O(log n) time

Let $x = O\left(\sqrt{\log n}\right)$ ..... Optioin (B)

For $\sqrt{\log n}$ elements $\rightarrow \sqrt{\log n} \cdot \log \sqrt{\log n}$

$= \frac{1}{2} \sqrt{\log n} \cdot \log (\log n)$

$\neq \log n$

Consider option (C)

$x = \theta\left(\frac{\log n}{\log(\log n)}\right)$ elements

$\therefore$ Time $= \frac{\log n}{\log(\log n)} \log \left(\frac{\log n}{\log(\log n)}\right)$

$= \frac{\log n}{\log\log n} . \log\log n - \frac{\log n}{\log\log n} \underbrace{\log\log\log n}_{\text{negligible}}$

$= \theta (\log n)$

$\therefore$ (C) is the answer.

31. The first for loop will run $\frac{n}{2}$ times i.e. O(n)

The second for loop will run log n times

The value of k is updated log n times i.e.

$\frac{n}{2}$ is added to it log n times

$\therefore$ For inner for loop, k = O (n . log n)

whereas for outer loop, k = n.n log n

$= O(n^2 \log n)$

$\therefore$ (B) is the answer

32. L_1 $\{0^p1^q0^r \mid p, q, r \geq 0\}$

$L_1 = 0^*1^*0^*$ $\therefore$ L_1 is regular

$L_2 = \{0^p1^q0^r \mid p, q, r \geq 0, p \neq r\}$

$\therefore$ L_2 is CFL as there is a relation between p and r

(A) is true

(B) is true as CFLs are intersected with regular languages

(C) is true as complement of a CFL may or may not be a CFL but it is definitely recursive.

(D) is false as L_1 is regular and hence complement of L1 is also regular.

$\therefore$ (D) is the answer.

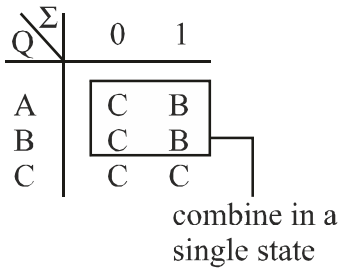
33. Statement 1 is true as L(A) is regular and hence complement of L(A) is also regular.

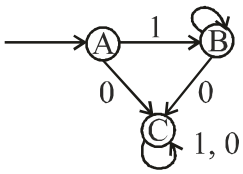
∴ L(A) is context free as well.

Statement 2 is true.

L(A) = (11*0 + 0) (0 + 1)* 0 * 1*

Statement 3 is false as the minimized DFA is of two states.





Statement 4 is false as the DFA does not accept 11.

∴ (D) is the answer

34. S = 2 initially and x = 0

I	P(S)	P(S)	P(S)	P(S)
II	Read (X)	Read (X)	Read (X)	Read (X)
III	X = X + 1	X = X + 1	X = X – 2	X = X – 2
IV	Store (X)	Store (X)	Store (X)	Store (X)
V	V(S)	V(S)	V(S)	V(S)

W executes (I) ∴ $\boxed{S=1}$

(II) Read (X) X = 0

(III) X = X + 1 ∴ $\boxed{X=1}$

(IV) store X = 1 in memory

X executes (I) S = 0

∴ X = 1 will be read as value of X = 1 is stored in memory.

Now let W execute (V)

∴ S = 1

Let Y execute (I) $\boxed{S=0}$

(II) Read X : $\boxed{X=1}$

Let X execute (III)

$\therefore$ X = X + 1 $\Rightarrow$ $\boxed{X = 2}$

Let Y execute (III)

X = X – 2 $\Rightarrow$ X = 1 – 2 = –1

Y executes (IV)

Store (X) $\boxed{X = -1}$ stored in memory

Y executes (V)

V(S) $\therefore$ $\boxed{S = 1}$

Let Z execute (I) & (II)

$\therefore$ S = 0 $\boxed{X = -1}$

(III) X = –1 –2 = –3

(IV) Store X $\therefore$ $\boxed{X = -3}$

Now let X execute (IV)

As X had alredy performed (III) and $\boxed{X = 2}$ will be stored and overwritten everywhere in memory

$\therefore$ Maximum value of X = 2

(D) is the answer.

35. All the four queries give the same result

(I) is an SQL query

(II) is a relational algebra query

(III) is a Tuple relational calculus expression

(IV) is a domain relational calculus expression

$\therefore$ (A) is the answer

36. For ethernet LAN,

Tt $\geq$ 2Pt

$$\frac{L}{BW} \geq 2\frac{d}{V}$$

$$\therefore\ d < \frac{L}{BW} \times \frac{V}{2}$$

$$\therefore\ d \leq \frac{10000b}{500\times10^{6}\text{bps}} \times \frac{2\times10^{5}\text{km/s}}{2}$$

$$\therefore\ d\ \frac{10^{9}}{500\times10^{6}}\ \text{km}$$

$\therefore$ d $\leq$ 2 km

$\therefore$ d_{max} = 2 km

(B) is the answer.

37. The M bit is 0. Hence it is the last fragment

Total length = 400

HLEN = 10

$\therefore$ Header length = 10 × 4 B = 40B

Data excluding header = 400 – 40 = 360B

Fragmentation offset = 300

Fragmentation offset is scaled in 8 bytes

$\therefore$ First byte of data = 300 0+ 8 = 2400

and last byte of data = 2400 + 360 – 1 = 2759

$\therefore$ (C) is the answer.

38.
- Coupling refers to the degree of interpendence between software modules.
- Cohesion refers to the degree to which elements of a module belong together.

$$\text{Coupling between M1 \& M2} = \frac{\text{No. of external links}}{\text{No. of modules}}$$

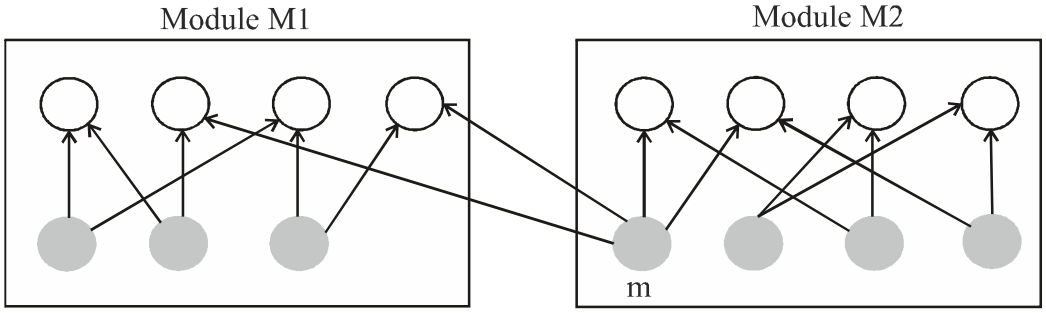
$$= \frac{2}{2}$$

$$\text{Cohesion of a module} = \frac{\text{No. of links}}{\text{No. of methods}}$$

$$\text{Cohesion of M1} = \frac{8}{4} = 2$$

$$\text{Cohesion of M2} = \frac{6}{3} = 2$$

After moving m to M2



Coupling = $\frac{2}{2}$ = 1

Cohesion of M1 = $\frac{6}{3}$ = 2

Cohesion of M2 = $\frac{8}{4}$ = 2

There is no change

(A) is the answer.

39. For the given process, the execution sequence should be alternated by the process X and Y.

(A) leads to deadlock

(B) In there is a possibility that only X is executed for a long time

(C) produces the correct result. The execution sequence is YXYX....

(D) There is no strict alternation here

$\therefore$ (C) is the answer.

40. 1 is false as merging is done when look aheads are different which is true in the given case.

2 is false as there is no complete item (i.e. $X \rightarrow c.$). Hence no SR conflict.

3 is false as there is not a pair of complete items (i.e. $X \rightarrow c$. and $X \rightarrow d.$). Hence no RR conflict.

4 is false as it is possible to merge the two sets of LR(1) items.

$\therefore$ All statements are false

(D) is the answer.

41. 1 is true. Emptiness property for CFGs is decidable

2 is false as it is indecidable for a CFG G that $L(G) = \sum *$

3 is false. It is undecidable if L(M) is regular, M being a Turning machine.

4 is true as NFA and DFA have equal expressive power. So it is decidable.

$\therefore$ (D) is the answer.

42. Since x is passed by reference, all functions will have same value of x.

x = 5 initially

f (5, 5) = f(x, 4) * x

= f(x, 3) * x * x

= f(x, 2) * x * x * x

= f(x, 1) * x * x * x * x

Also x is incrementated in every function call

∴ After 4 function calls,

x = 5 + 4 = 9

∴ f(5, 5) = 1 * 9^4 = 6561

(B) is the answer.

43. Preorder traversal of BST is : [Root – Left – Right]

30, 20, 10, 15, 25, 23, 39, 35, 42

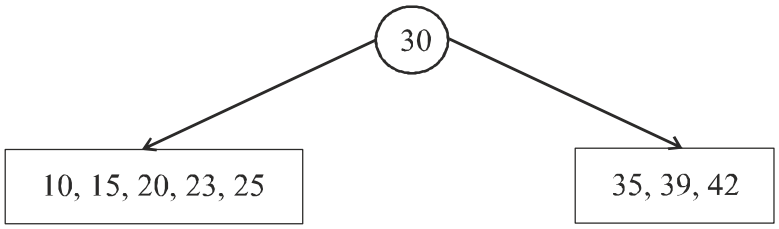
- Note that inorder traversal of a BST is the increasing order of that sequence.

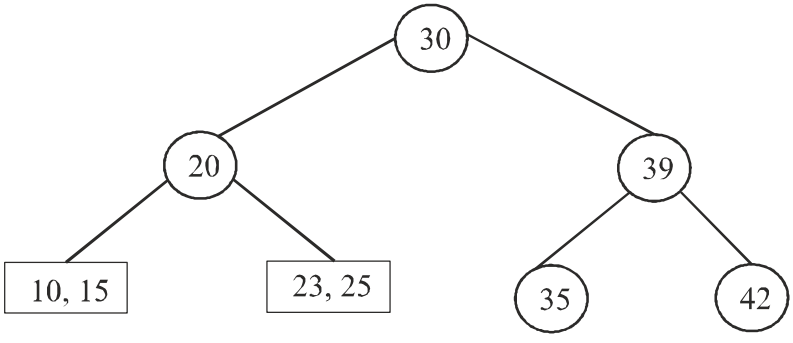
∴ Inorder traversal is [Left – Root – Right]

10, 15, 20, 23, 25, 30, 35, 39, 42

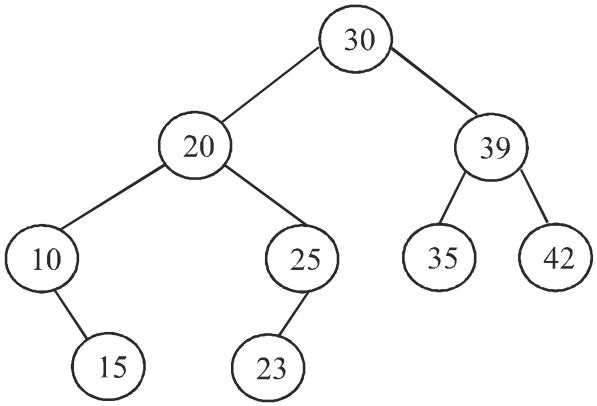
Now, we can construct a unique BST from the pre-order and inorder traversal.

∴ 30 is the root (from preorder traversal)





∴ Tree is



Now, post order traverssal (Left – Right – Root) of the obtained tree is :

15, 10, 23, 25, 20, 35, 42, 39, 30

$\therefore$ (D) is the answer.

44. For each Multi Dequeue ( ) operation, the while loop will be tested once.

But since queue is initially empty, the condition in the while loop never becomes true.

$\therefore$ For 'n' Multi Dequeue ( ) operation, the while loop will be tested 'n' times and not even once it becomes true.

$\therefore$ Worst case time complexity = θ (n)

(A) is the answer.

45. For pipeline,

t_p = max (5, 7, 10, 8, 6) + 1 ns

= 10 + 1

t_p = 11 ns

A program has 12 instructions I_1 , I_2 ..... I_{11}, I_{12}

I_4 is the only branch and its branch target is I_9.

$\therefore$ Execution sequece : I_1, I_2, I_3, I_4, I_9, I_{10}, I_{11}, I_{12}

Till I_4, execution time = 7 cycles

(Till 4th stage of I_4 i.e EI stage) = 7 × 11 = 77 ns.

WO of I_4 and and FI of I_9 will execute in parallel

$\therefore$ Execution time = 8 cycles

= 8 × 11 = 88 ns

$\therefore$ Total time = 77 + 88 = 165 ns

(B) is the answer.

46. RAM chip size = 1K × 8 [1024 words of 8 bits each]

RAM needed to constract = 16 K × 16

$$\therefore \text{ \# chips required} = \frac{\text{Total RAM size}}{\text{chip size}}$$

$$= \frac{16K \times 16}{1K \times 8}$$

$$= 16 \times 2$$

i..e 16 chips vertically with each row having 2 chips.

Hence to select one chip out of 16, we need a 4 × 16 decoder whereas available is 2 × 4 decoder

$\therefore$ No . of 2 × 4 decoders needed = 4 + 1 = 5

Note : To construct m × n decoder using multiple p × q decoders, number of p × q decoders needed are ceil $\left\lceil \frac{n-1}{q-1} \right\rceil$

Here n = 16, q = 4

$$\therefore \text{ \# decoders} = \frac{16-1}{4-1} = \frac{15}{3} = 5$$

$\therefore$ (B) is the answer.

47. We know that

$= \neg(\forall x P(x)) \leftrightarrow \exists x \neg P(x)$

Given statement is $\neg\exists x(\forall y(\alpha) \wedge \forall z(\beta))$

$= \forall x(\neg \forall y(\alpha) \vee \neg \forall z(\beta))$

$= \forall x(\forall y(\alpha) \rightarrow \neg \forall z(\beta))$

$= \forall x(\forall y(\alpha) \rightarrow \exists z(\beta))$

Which is same as option (C)

$\therefore$ C is logically equivalent to the given statement.

If P $\rightarrow$ Q, then $\neg$ Q $\rightarrow \neg$ P (using the result of contrapositive)

$\therefore$ Option (C) can be written as

$\forall x(\forall z(\beta) \rightarrow \exists y(\neg\alpha))$

Which is same as option (B)

$\therefore$ (B) is logically equivalent to the given statement.

However neither of (A) and (D) are logically equivalent to the given statement. Hence both are correct answers.

In GATE 2013, marks were given to all for this question.

48. Code motion can be done as follows :

```
c = a + b;          // a & b is registers and b is replaced by result c i.e. b = a + b
x = c × c;          // x replaces register c and hence c is spilled to memory
```

Now for minimum spills to memory, consider the best case.

i.e. (x > a) is true

∴ Only one memory spill i.e. of register 'c'

(B) is the answer.

49.

c = a + b;	b = a + b	$R_2 = R_1 + R_2$
d = c * a;	d = b * a	$R_3 = R_2 * R_1$
e = c + a;	e = b + a	$R_4 = R_2 + R_1$
x = c * c;	b = b * b	$R_2 = R_2 * R_2$
if (x > a)	b > a	$R_2 > R_1$
{		
y = a * a;	a = a * a	$R_1 = R_1 * R_1$
}		
else		
{		
d = d * d;	d = d * d	$R_3 = R_3 * R_3$
e = e * e;	e = e * e	$R_4 = R_4 * R_4$
}		

∴ For zero memory spills, we need 4 registers

(B) is the answer.

50. The code is flawed when an old character is replaced by a new character and again the corresponding new character is replaced by another new character.

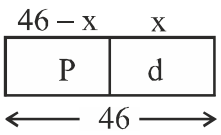
The flaw occurs in test cases (3) and (4) i.e. only 2 test cases.

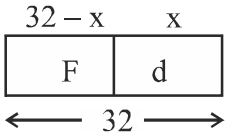
(B) is the answer.

51. The test cases (3) and (4) contain the flaw.

(C) is the answer.

52. L.A = V.A = 46 bit PA = 32 bit





Let the page size 'd' be 2^x Bytes

Since first level page table T1 occupies exactly one page,

Size of T1 = 2^x B

We know that

Size of page table = #entries * PTE

$\therefore$ # entries in T1 = $\frac{2^x}{4}$

Also,

number of entries in T1 = number of second level page tables.

(Because each entry of T1 stores the base address of the second level table T2)

$\therefore$ size of T2 = $\left(\frac{2^x}{4}\right) * 2^x$

Similarly

entries in T2 = number of third level page tables

$= \left(\frac{2^x}{4}\right) * \left(\frac{2^x}{4}\right)$

$\therefore$ Size of T_3 = $\left(\frac{2^x}{4}\right) * \left(\frac{2^x}{4}\right) . 2^x$

Now,

Total no. of pages in T_3 = $\left(\frac{2^x}{4}\right) \cdot \left(\frac{2^x}{4}\right) \left(\frac{2^x}{4}\right)$

$= \frac{2^{3x}}{2^6}$

$= 2^{3x-6}$

Also of size of virtual memory = 2^{46-x}

$\therefore$ $2^{46-6} = 2^{3x-6}$

$\therefore$ $46 - x = 3x - 6$

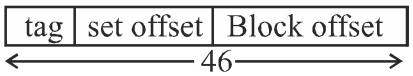
$\therefore$ $4x = 52$

$\therefore$ $\boxed{x = 13}$

$\therefore$ Page size = 2^xB = 2^{13}B = 8KB

(C) is the answer.

53. For set associative cache, format is



Block size = 64B

$= 2^6$B

Block offset $= \log_2 \lceil \text{Block size} \rceil$

$= \log_2 \lceil 2^6 \rceil$

$= 6$

$$\#\text{ Lines in cache} = \frac{\text{Cache size}}{\text{Block size}}$$

$$= \frac{1\text{MB}}{64\text{B}}$$

$$= \frac{20^{20}}{2^6\text{B}}$$

$= 2^{14}$

$$\#\text{ Sets} = \frac{\#\text{Lines}}{\text{P} - \text{way}}$$

$$= \frac{2^{14}}{16}$$

$$= \frac{2^{14}}{2^4}$$

$= 2^{10}$

Set offset $= \log_2 \lceil \#\text{Sets} \rceil$

$= \log^2 \lceil 2^{10} \rceil$

$= 10$

$\therefore$ tag bits $= 46 - (6 + 10)$

$= 30$ bits

For virtually indexed and physically tagged cache, if number of bits in page offset = (set + block) offset then only one page color is sufficient.

However, in this case

bits in page offset = 13 (as page size = 8 KB)

bits in (set + block) offset = 6 + 10 = 16 i.e. 3 bits of cache index overlap with physical page number.

$\therefore$ We need 2^3 i.e. 8 different colors.

(C) is the answer.

54. $(A)^+ = ABCFHGE$

The FDs do not contain the attribute 'D'

i.e. D is a multivalved attribute.

$\therefore (AD)^+ = ABCDEFGH$

$\therefore$ AD is a candidate key.

Also, we have $E \rightarrow A$

$\therefore ED \rightarrow AD$

i.e ED is a candidate key too

Also, we have $F \rightarrow E$ (as $F \rightarrow EG \therefore F \rightarrow E \& F \rightarrow G$)

$\therefore FD \rightarrow ED$

i.e. FD is also a candidate key

Also, we have $B \rightarrow F$ (as $B \rightarrow CFH \therefore B \rightarrow C, B \rightarrow F \& B \rightarrow H$)

$\therefore BD \rightarrow FD$

i.e. BD is a candidate

$\therefore$ we have four candidate keys – AD, ED, FD and BD

(B) is the answer

55. For the given relation, AD, ED, FD & BD are candidate keys.

Prime attributes = {A, B, D, E, F} and we have

$A \rightarrow C$

i.e. a proper subset of candidate key $\rightarrow$ non key

$\therefore$ The relation is not in 2NF

(A) is the answer.

GENRAL APTITUDE SECTION (Q. NO. 56 – 65) 15 MARKS

56. Nadir means the lowest point. It is the opposite of zenith (the highest point).
(B) is the answer.

57. The analogy here is of words having opposite meaning.
Diffuseness means to spread widely.
$\therefore$ (A) is the answer.

58. The series 44, 42, 40, ... is in A.P. with common difference 2.
For maximum sum, we should consider the series upto 0 or 2.
$\therefore$ 44, 42, 40 2
No. of terms in an AP = 22
First term = 44
Last term = 2

$$\therefore \text{ Sum of A.P} = \frac{n}{2}\left[a_1 + a_n\right]$$

$$= \frac{22}{2}\left[44 + 2\right]$$

$$= 506$$

(C) is the answer.

59. (A) is the answer
If I were a bird, I would fly in the sky.

60. (C) is the answer
Correct sentence is : She is a European as here in European, the sound is of 'u'
Hence, we use the article 'a' & not 'an'.

61. Rationalize each term in the series

$$\therefore \frac{1}{\sqrt{1}+\sqrt{2}} \times \frac{\sqrt{1}-\sqrt{2}}{\sqrt{1}-\sqrt{2}} = \frac{\sqrt{1}-\sqrt{2}}{-1} = \sqrt{2}-\sqrt{1}$$

$$\frac{1}{\sqrt{2}+\sqrt{3}} \times \frac{\sqrt{2}-\sqrt{3}}{\sqrt{2}-\sqrt{3}} = \frac{\sqrt{2}-\sqrt{3}}{1} = \sqrt{3}-\sqrt{2}$$

Similarly, $\frac{1}{\sqrt{80}+\sqrt{81}} = \sqrt{81}-\sqrt{80}$

$\therefore$ Series will be as follows :

$S = \sqrt{2}-\sqrt{1}+\sqrt{3}-\sqrt{2}+\sqrt{4}-\sqrt{3}$ ..... $+\sqrt{81}-\sqrt{80}$

$S = 9 - 1$

$\therefore S = 8$

(B) is the answer

62. In 1 – 100,

no. of integers divisible by 7 = $\frac{100}{7}$ = 14.28

$\therefore$ 14 numbers are divisible by 7

No. of two digit integers divisible by 7 = 14 – 1

= 13

[i.e. excluding 7]

no. of two digit numbers in 1 – 100 = 90

$\therefore$ Required probability = $\frac{90-13}{90}=\frac{77}{90}$

(D) is the answer.

63. Clearly, the options (A), (B) and (C) do not make sense. Only (D) supports the given information

$\therefore$ (D) is the answer.

64. Let the total distance be '4d' km

Half of the journey is covered at 60km/h

$\therefore t_1 = \frac{2d \text{ km}}{60 \text{ km/h}} = \frac{d}{30}$ h

Similarly,

$t_2 = \frac{d \text{ km}}{30 \text{ km/h}} = \frac{d}{30}$h

$$t_3 = \frac{d \text{ km}}{10 \text{ km/h}} = \frac{d}{10} \text{ h}$$

$$\therefore \text{ Average speed } = \frac{\text{Total distance travelled}}{\text{Total time taken}}$$

$$= \frac{4d}{t_1 + t_2 + t_3}$$

$$= \frac{4d}{\left(\frac{d}{30} + \frac{d}{30} + \frac{d}{10}\right) h}$$

$$= 24 \text{ km/h}$$

$\therefore$ (C) is the answer.

65. Let the current labour wages be W and working hours be H

$\therefore$ Cost = W × H

$\therefore$ W × H = 13200

According to given conditions,

$$\text{New cost } = \left(1 - \frac{1}{24}\right) H \times \left(1 + \frac{1}{5}\right) W$$

$$= \frac{23}{24} H \times \frac{6}{5} W$$

$$= \frac{23}{24} \times \frac{6}{5} \times 13200$$

$\therefore$ New cost = 15180

$\therefore$ (B) is the answer.