GATEFORUM
Engineering Success

GATE 2015 – A Brief Analysis
(Based on student test experiences in the stream of CS on 8th February, 2015 – (Morning Session)

Section wise analysis of the paper

Section Classification	1 Mark	2 Marks	Total Number of Questions
Engineering Mathematics	2	3	5
Discrete Mathematics	3	2	5
Digital Logic	1	2	3
Computer Organization	2	2	4
Theory of Computation	1	3	4
Data Structures & Algorithms	9	5	14
Compiler Design	1	3	4
Operating Systems	2	2	4
DBMS	1	3	4
Computer Networks	2	2	4
SEWT	1	3	4
Verbal Ability	2	3	5
Numerical Ability	3	2	5
	30	**35**	**65**

Disclaimer – This paper analysis and questions have been collated based on the memory of some students who appeared in the paper and should be considered only as guidelines. GATEFORUM does not take any responsibility for the correctness of the same.

Questions from the Paper

GATE 2015
8th February 9:00 to 12:00

1. Let f(x) be a linear function such that $f(-2) = 29$ and $f(3) = 39$. Find the value of f(5).

2. What is the value of the postfix operation?

3. Consider a program code which was fed with 100 artificial errors. On analyzing the errors, 159 errors were reported of which 75 were the artificial errors that were initially seeded. What is the closest approximation of the number of errors in the program?

4. Question on <base href=" " >

5. Consider a power set U of a set $S = \{1, 2, 3, 4, 5, 6\}$. Let $T \in U$ such that T' denotes the compliment of the set and |T| denote the number of elements in T. Let T/R denote the set of elements which are T but not in R. Which of the following is true?

    (A) $\forall X \in U(|X| = |X'|)$

    (B) $\exists X \exists Y \in U(|X| = 5, |Y| = 5, X \cap Y = \phi)$

    (C) $\forall X \forall Y \in U(|X| = 2, |Y| = 3, X/Y = \phi)$

    (D) $\forall X \forall Y \in U(X/Y = Y'/X')$

6. The maximum number of processes that can be in READY state on a processor with n CPUs is?

    (A) n   (B) $n-1$ (C) 2^n (D) Independent of n

Key: (D)

Exp: Number of processes which are in running process will be atmost n as there are n processors. Maximum no. of processes that will be in ready state in independent of no. of processors.

7. Consider the following statements. Which of them is true?

    S1: TCP allows full duplex communication

    S2: TCP has no option for selective acknowledgments

    S3: TCP work as a message stream.

    (A) Only S1

    (B) Only S2

    (C) S1, S2, S3

    (D) S1 and S3, but not S2

---

8. Consider a hash table with 25 slots and 200 entries. What is the load factor α of the hash table?

9. Consider the following relation table:

table(theatre, address capacity)

What should be written at the end of this query

Select P1.address

From table P1

Such that it returns the theatre with maximum capacity?

(A) Where capacity > = ALL(select P2.capacity from table p2)

(B) Where capacity > = ANY(select P2.capacity from table p2)

(C) Where capacity > ALL(select P2.capacity from table p2)

(D) Where capacity > ANY(select P2.capacity from table p2)

Key: (A)

Exp: Inner query collects capacities of all the theatres and in outer query we are filterin the tuples with the condition "capaicty>=All". So the theatres which are having maximum capacity will be satisfy the conductivity and they will.

10. How many 4-digit numbers can be formed such that the digits are in non-decreasing order (from left to right) using only digits {1, 2, 3}?

11. Question on critical section where two processes P_1 and P_2. It asks about mutual exclusion and deadlock.

12. Consider the equation $\Sigma i^3 = X$. Also consider the following:

   i. $\theta(n^4)$

   ii. $\theta(n^3)$

   iii. $O(n^5)$

   iv. $\Omega(n^5)$

Which of the above can correctly replace X?

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

Key: (C)

Exp: X= sum of the cabes of n natural numbers $= \dfrac{n^2(n+1)^2}{4}$ which is $\theta(n^4), 0(n^5) \& \Omega(n^3)$.

13. Consider the following C code:

```
#include<stdio.h>
main(){
char s1[7] = "1234", *p;
```
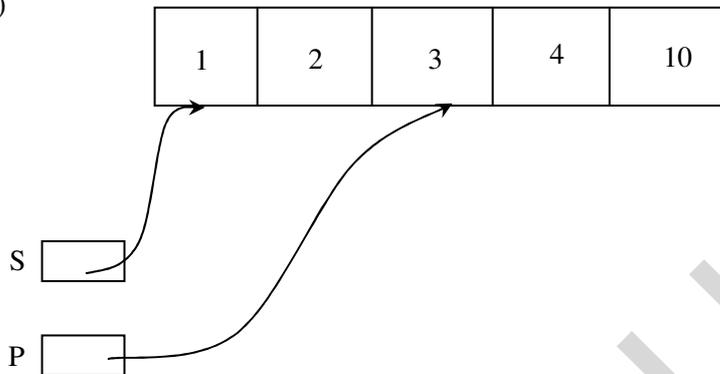
```
p = s1+2;
*p = '0';
Printf("%s", s1);
}
```

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

Key: (1204)

Exp:

| 1 | 2 | 3 | 4 | 10 |

S

P

After *P = '0'.

| 1 | 2 | 3 | 4 |

S

and we are pointing strife s which is 1204.

14. Let # be a binary operator such that:

$X\# = X'+ Y'$

Consider the following two statements:

$S1:(P\#Q)\#R = P\#(Q\#R)$

$S2:Q\#R = R\#Q$

Which of them is correct?

15. Consider the language $L = \Sigma * 0011\Sigma *$ where $\Sigma = \{0,1\}$. What is the minimum number of states in the DFA of compliment of L i.e. L'?

16. The elements 71, 65, 84, 69, 67, 83 are inserted in a binary search tree. The element in the lowest level is?

Exp:
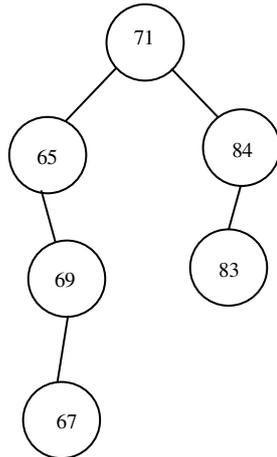
17. Consider the following elements:

$< 85, 19, 50, 17, 11, 12, 15, 8, 9, 6, 5, 2, 100 >$

The minimum number of interchanges required to convert this into a max-heap is?

Exp: 1st snap is between 100 & 12

2nd snap is between 100 & 50

3rd snap is between 100 & 85.

18. The limit evaluates to:

$$\lim_{x \to \infty} (1 + x^2) e^{-x}$$

(A) 1   (B) $\frac{1}{2}$ (C) -1 (D) ∞

19. Given a relation (PQRTUV) and the following two functional dependencies:

PQ -> RS.

Which of the following is a trivial FD which can be implied from F+ over F?

20. CSMA/CD question to find speed of signal:

Ans: $\dfrac{1250 * 8}{10^8} \geq 2 * \dfrac{1}{x}$

Exp: Given L=1250 Bytes

B= 100 mbps

d= 1km

V=?

In CSMA/CD, $L = 2 \times \dfrac{d}{v} \times B$

$$\Rightarrow V = \frac{2dB}{L} = \frac{2 \times 10^3 \times 10^{84}}{10^4}$$

$$\Rightarrow V = 20,000\, KM / sec$$

(or)

$$V = 0.2 \times \omega^8 \, m / s$$

21. Consider a binary tree with 200 leaf nodes. What is the number of nodes having exactly two children?
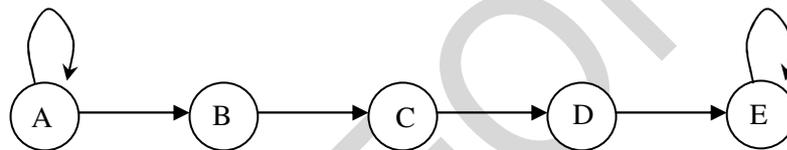
Key: 399

Exp: $p = \frac{n+1}{2}$

$p = 200$

$200 = \frac{n+1}{2}$

$2(200) = n + 1$

$n = 400 - 1 = 399$

A	AB	A
B	C	–
C	–	D
D	–	E
E	E	E
AB	ABC	A
ABC	ABC	AD
AD	AB	AE
AE	ABE	AE
ABE	ABCE	AE
ABCE	ABCE	ADE
ADE	ABE	AE

22. Consider a $2^{\wedge}20$ byte addressable main memory and block size of 16 bytes with a direct mapped cache of $2^{\wedge}12$ cache lines. Two bytes are consecutively stored in the memory addresses $(E201F)_{16}$ and $(E2020)_{16}$. What is the tag and cache line address of address $(E201F)_{16}$?

(A) E, 201   (B) E, E201   (C) F, 201   (D) ..

23. There are types of people. Type 1 always tells the truth and Type 2 always tell the lie. A coin is tossed by one person whose type is unknown. He does not tell the result of coin toss till asked. Upon asking, he replies:

"The coin toss has resulted in heads if and only if I tell the truth"

Which is the following is true?

(A) Result is head

(B) Result is tail

(C) If person is Type 1, then result is tail

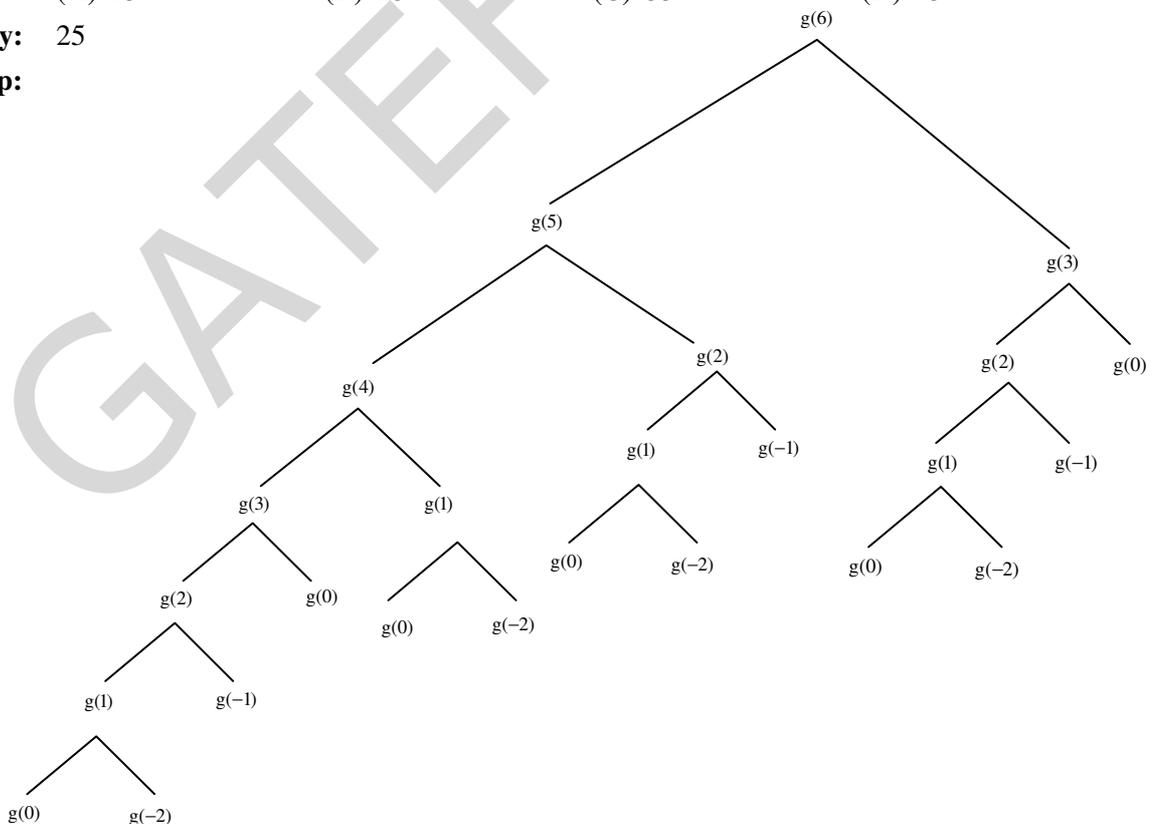(D) If person is Type 2, then result is tail

24. Consider the following C code:

$get\,int\,(n)$

```
{
    if (n < 1) return;
    get (n - 1);
    get (n - 3)
    print f ("%d", n);
}
```

If the above function is called from main() with get(6), then the number of times the get() recursive call is made?

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

Key: 25

Exp:

25.   Question about GoBackN and minimum number of bits in sequence number. W>= 1+2a

26.   A language L1 is polynomial time reducible to L2. A language L3 is also polynomial time reducible to L2, which in turn is polynomial time reducible to L4. Which of the following statement are true?

i.   If $L4 \in P$, then $L2 \in P$

ii.

iii.

iv.   If $L4 \in P$, then $L1 \in P$ and $L3 \in P$

Key: (C)

Exp: $L_2 \le pL_4$

$L_1 \le pL_2$

If $L_4 \in P$ then $L_2 \in P$ hence $L_1 \in P$ hence option C.

27.   Mergesort algorithm takes about 30 seconds on an input of 64 elements. What is the correct approximation for the number of elements that can be sorted in 6 minutes using mergesort?

Key: 256

Exp: Time complexity $= 0(n \log n)$

$0(n \log n) = 30s.$

$n = 64$

$\theta(64 \times \log 64) = 30$

hence will set factor of 12.8.

for 3 min.

$\quad = 3 \times 60$

$0(256109256) \Rightarrow 180$

will get factory of 11.37

for 512 will get 25.6.

for 1024 will get 56.8

for 2048 will get 125.155

hence 256 is near to answer.

28.   Consider a network 200.10.11.144/27. What is the value of the last octet (in decimal) of the last host in this network?

Key:

Exp: Given IP address 200.10.11.144/27

To find out the loss address in a block, we have to set (32-4) no. of right most bits to 1.

n=27

$32 - n = 32 - 27 = 5$

200.10.11.10011111

200.10.11.159

∴ CDR Address range is 200.10.11.128/27-200.10.11.159/27

But w.r.t the question, the volume of the last octet of last host in this n/w is

200.10.11.158.

29. Consider two functions:

$f(n) = n$

$g(n) = n^{(1+\sin n)}$

Then which is correct

$f(n) = O(g(n))$

$g(n) = O(f(n))$

Exp: As -1≤sinx≤1, neither of them is true

30. Consider a relation R on ordered pair of integers such that $((p,q),(r,s)) \in R$ If $p - s = q - r$.

Which of the following is true about the relation R?

(A) Reflexive and Symmetric

(B) Not reflexive but symmetric

(C) Reflexive but not symmetric

(D) Not reflexive nor symmetric

Key: (B)

Exp: R is reflexive if (p,q) R (p,q) ∀ p,q ∈ z

(p,q) R (p,q) if p-q = q-p which is false

∴ R is not reflexive

R is symmetric is (p,q) R (r,s) then (r,s) R (p,q)

If (p,q) R (r,s) then p-s = q-r

If (r,s) R (p,q) then r-q = s-p which is true when p-s = q-r

∴ R is symmetric

31. A graph consists of 100 vertices and 300 edges. The minimum spanning tree of the graph has a weight of 500. The weight of each edge is then increased by 5. The weight of the new MST is___.

Key: 995

Exp: 100 vertices and weight 500

So there 99 edges with weight 500.

Consider one instances

where 98 edges have weight 5

and one edge having weight 10

no we have to increase weight by 5.

Hence, $98 \times 10 + 15 = 995$

32. Mccabe cyclomatic complexity of two modules A and B, and their combined cyclomatic complexity: Answer: 4,4,7

33. Two hosts communicate using packet switched. The hosts are connected via a switch over 10^7 bit per second links. The propagation delay on both links is 20 microseconds. The hosts send a total of 10000 bits in two packets of 5000 bits each. The switch waits for 35 microseconds between sending a frame and receiving a frame. What is the total delay (in microseconds) between sending the last bit and receiving the first bit?

34. The function $af(x) + bf\left(\dfrac{1}{x}\right) = \dfrac{1}{x} - 25$. What is the value of $\int_1^2 f(x)\,dx$?

(A) $\dfrac{1}{a^z - b^z}\left\{a(\ln 2 - 25) + \dfrac{47b}{2}\right\}$

35. The maximum number of possible solutions to the equation $(43)_x = (y3)_8$ are:

Key: (5)

Exp: $(43)_x = (y3)_8$

$\Rightarrow 3 + 4x = 3 + 8y \Rightarrow 4x = 8y$

$\Rightarrow x = 2y$

$\Rightarrow x \geq 5$ and $y \leq 7$

$\therefore$ 5 solutions are possible which are (14,7), (12,6), (10,5), (8,4) and (6,3)

36. Consider the following code fragment:

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

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

$int\, f_1( )\{int\, x = 25; x + +; return\, x;\}$

$int\, f_2( )\{static\, int\, 50; x + +; return\, x;\}$

$int\, f_3( )\{x* = 10; return\, x;\}$

What is the output?

(A) i only   (B) ii only   (C) I & iii   (D) I & ii

Key:

Exp: $a^m b^n a^n b^m \Rightarrow$ This one is CFL

$a^m b^n a^m b^n \Rightarrow$ by pumping lemma this one is not CFL.

$\{a^m b^n | m = 2n + 1\}$ This is CFL.

37.   An array $C = <c_0, c_1 .. c_{k-1}>$ has elements from either 0 or 1. Consider the following code:

```
DoSomething(c,a,n)
{
    z < −1
    For i = 0 to k − 1
    do
                    z < −z² mod n
                    if c[i] = 1
                    z < −a * z  mod n
    end
    return z;
}
```

If $k − 4, c = <1, 0, 1, 1>, a = 2,$ and $n = 8$, what is the value returned?

Key: **(0)**

Exp:

C	i	0	1	1

$2 = 0$

20 something

{z = 1
for i = 0 + 0.3
do

	$k = 0$			
	$z = 1$			

$z < -2^2 \bmod$
   if $c[i] = 1$
$z < -2 \times 2 \bmod 8$
   end
   return 2}

$z < -2^2 \bmod$	$z = 1$	$z = 4$	$z = 0$	$z = 0$
if $c[i] = 1$	$c[0] = 1$	$c[1] = 0$	$c[1] = 1$	$c[1] = 1$
$z < -2 \times 2 \bmod 8$	$z = 2$		$z = 0$	$z = 0$

Ans: z=0

38. Which of the following is a context free language?

i. $\{a^m b^n a^n b^m\}$

ii. $\{a^m b^n a^m b^n\}$

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

39. Consider a binary function $F = P' + QR$ such that $P' = !P$. Which of the following is correct for F?

i. $F = \Sigma(4,5,6)$

ii. $F = \Sigma(0,1,2,3,7)$

iii. $F = \Pi(4,5,6)$

iv. $F = \pi(0,1,2,3,7)$

(A) only A   (B) only B   (C) Both B & C   (D) Both A & C

Key:

Exp: $F = P' + QR$

P \ QR	00	01	11	10
0	1	1	1	1
1	0	0	1	0

hence $\sum(0,1,2,3,7)$

$\pi(4,5,6)$

41. A B+ tree has a search value field of 12 Bytes, a record pointer of ..bytes, and a block pointer of 8 bytes with block size 1024. What is the maximum number of keys that can be accommodated in a non-leaf node?

Key: 50

Exp: Suppose that 'k' is order of the non-leaf node

k(8)+(k-1)12 ≤ 1024

20k≤1036

$$k \leq \left\lfloor \frac{1036}{20} \right\rfloor \Rightarrow k \leq 51$$

As the order is 51, maximum we can store 50 keys

42. Consider the following C Code:

```
#inlcude < stdio.h >
void main( )
{
int a{10,20,30,40,50};
int* p[ ]={a,a+3,a+4,a+1,a+2}
int**ptr;
ptr = &p;

ptr++;
printf("%d%d", ptr-p, **ptr);
}
```

What is the output?

43. CO question about data dependence in pipeline:

OP OP r_1, r_2, r_3 implies $r_1 < -r_2$ OP r_3

There are five instructions to be executed. ……..

44. X is a two dimensional matrix such that X is initialized as $X[I, j] = i + j,$ and Y is a one dimensional matrix with all zero's. Two code fragments are given.

In one: $y[i]+ = x[0][i]$ and in another $y[i]+ = x[i][0]$

45. Question about Simpson's 1/3rd rule

46. Question about computing Function point after providing all the parameter values

47. Question about smallest turnaround time in OS after providing four processes:

Process	Arrival Time	Duration
P_0	0	4
P_2	1	6
P_3	5	4
P_4	6	2

(Values may be inaccurate)

Exp: Given snapshot

Process	AT	BT
P_0	0	4
P_1	1	6
P_2	4	3
P_3	6	2

(A) Gautt chart:

	AT	BT	LT	TAT
P_0	0	4	4	4
P_1	1	6	10	9
P_2	4	3	13	9
P_3	6	2	15	9

P_0	P_1	P_2	P_3
0 4	10	13	15

$$\frac{31}{4} = 7.75$$

(B) SJF(Non-preemption)

	AT	BT	LT	TAT
P_0	0	4	4	4
P_1	1	6	15	14
P_2	4	3	7	3
P_3	6	2	9	3

$$\frac{24}{4} = 6$$

Gautt Chart

P_0	P_2	P_3	P_1
0 4	7	9	15

$p_1 - 6$ $p_1 - 6$ $p_1 - 6$

$p_2 - 3$ $p_3 - 2$

(C) SRTF

	AT	BT	LT	TAT
P_0	0	4	4	4
P_1	1	6	15	14
P_2	4	3	7	3
P_3	6	2	9	3

$$\frac{24}{4} = 6$$

Gautt Chart

P_0	P_2	P_3	P_1

0   4   7   9   15

P_0	P_0	P_2	P_2	P_3	P_1

0   1   4   6   7   9   15

$p_0 - 3$ $p_1 - 6$ $p_1 - 6$ $p_1 - 6$ $p_1 - 6$

$p_1 - 6$ $p_2 - 3$ $p_2 - 1$ $p_3 - 2$

$p_3 - 2$

(D) R.R   (T.Q=2)

	AT	BT	LT	TAT
P_0	0	4	6	6
P_1	1	6	15	14
P_2	4	3	13	9
P_3	6	2	12	6

$$\frac{35}{4} = 8.7 \Rightarrow R.Q: \cancel{P_0}\cancel{P_1}\cancel{P_0}\cancel{P_2}\cancel{P_1}\cancel{P_3}\cancel{P_2}P_1$$

Gautt Chart

P_0	P_1	P_0	P_2	P_1	P_3	P_2	P_1

0   2   4   6   8   10   12   13   15

49.   Consider the following system of equation with a non-trivial solution

$px + qy + rz = 0$

$qx + ry + pz = 0$

$rx + py + qz = 0$

50.   Consider two transactions:

  T1   T2

  Read(A)

  Write(A)

           Read(C)

           Write(C)

           Read(B)

           Write(B)

           Read(A)

           Commit

  Read(B)

  If the transaction T1 fails after the execution of Read(B), then which is true?

  (A) Recoverable

  (B) Non-recoverable

Key: (B)

Exp: T_2 is reading the value written by T_1 and getting committed before T_1 commits. So it is non-recoverable schedule

51.   Consider three random variables X_i with $i = \{1,2,3\}$. X_i is either 0 or 1 for $i = \{1,2,3\}$ Consider another variable $Y = X_1.X_2 \oplus X_3$. What is the probability of $P\big[Y = 0 \big| X_3 = 0\big]$?

52.   A graph was given and asked about correct equation:

Exp: $x = -\big(y - |y|\big)$

53.   A code fragment was provided with case statement and asked how many times printf statement will be printed.