BYJU'S EXAM PREP

GATE 2023

Computer Science & IT Engineering

Questions & Solutions

Memory Based

GATE 2023 CS & IT Engg. : Major Highlights

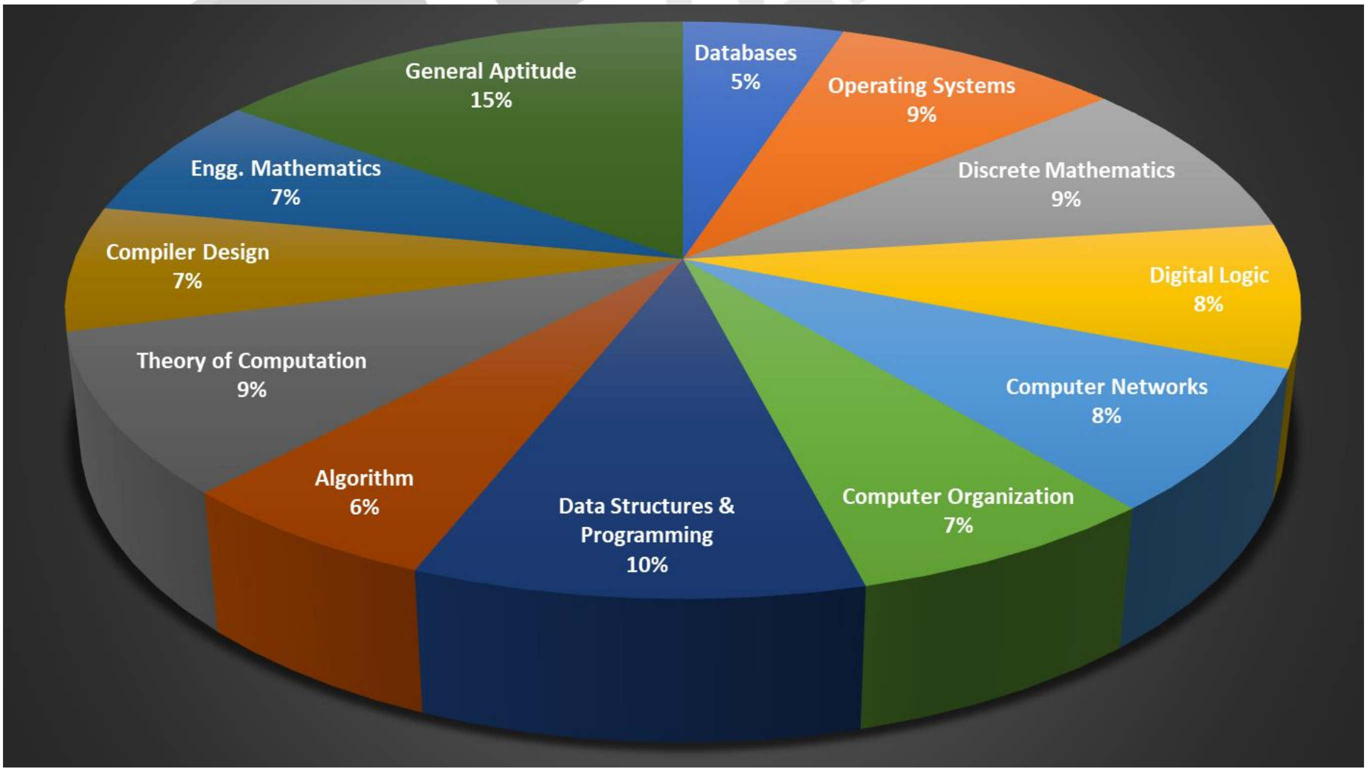
- Questions more difficult from Computer Network (Application Layer)
- Paper was Moderate to Tough
- Few questions were easy
- MCQ : 34Qs, MSQ : 15Qs and NAT 16Qs
- MCQ : 52 Marks, MSQ : 22 Marks and NAT 26 Marks
- More Descriptive questions

GATE 2023 CS & IT Engg. : Comparison with last Years' Data

S.No.	Subject Name	2023	2022	2021	
				Set-1	Set-2
1	**Databases**	**5**	7	8	8
2	**Operating Systems**	**9**	10	6	7
3	**Discrete Mathematics**	**9**	11	6	6
4	**Digital Logic**	**8**	3	6	5
5	**Computer Networks**	**8**	10	12	7
6	**Computer Organization**	**7**	9	5	8
7	**Data Structures & Programming**	**10**	10	8	9
8	**Algorithm**	**6**	7	13	9
9	**Theory of Computation**	**9**	8	8	11
10	**Compiler Design**	**7**	4	7	8
11	**Engg. Mathematics**	**7**	6	6	7
12	**General Aptitude**	**5**	15	15	15
	Total	**100**	**100**	**100**	**100**

GATE 2023 CS & IT Engg. : Subject-Wise Marks Distribution

Subjects	Questions		Total Marks
	1 Mark	2 Marks	
Databases	1	2	5
Operating Systems	3	3	9
Discrete Mathematics	1	4	9
Digital Logic	4	2	8
Computer Networks	2	3	8
Computer Organization	3	2	7
Data Structures & Programming	2	4	10
Algorithm	2	2	6
Theory of Computation	3	3	9
Compiler Design	1	3	7
Engg. Mathematics	3	2	7
General Aptitude	5	5	15
Total	30	35	100



Section – A (General Aptitude)

1. We reached the station late, and _______ missed the train.

[MCQ - 1 Marks]

A. Mostly B. Nearly
C. Utterly D. Near

Ans. B

Sol. Nearly is the answer for this question.

2. Two function of time (t) $f(t) = 0.01(t)^2$, $g(t) = 4t$ where $0 < t <$ ¥
(i) For some $t > 0$, $g(t) > f(t)$
(ii) There exists a T, such that $f(t) > g(t)$.

A. i-true B. ii-true
C. both true D. Both false

[MCQ – 2 Marks]

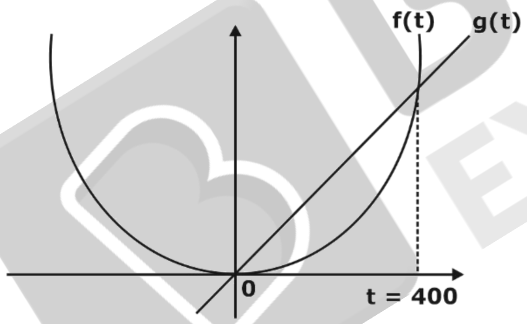
Ans. C

Sol. $f(t) = 0.01(t)^2$

$g(t) = 4(t)$

Intersection at $0.01(t)^2 = 4(t)$

$\Rightarrow t = 0, 400$



(i) True, because for $0 < t < 400$

$g(t) > f(t)$

(ii) True, because for $t > 400$

$f(t) > g(t)$

3. Kind: ________ ; often : frequently.

A. Cruel B. Mean
C. Type D. Kindly

[MCQ - 1 Marks]

Ans. C

Sol. Often and frequently are synonym. So, answer be similar to the meaning of the word kind. Kind is an adjective. It has two meanings (i) Nice, (ii) Type. Kindly can be used as adjective also and adverb also. Kind is generally related an individual act. Whereas kindly refers to general character of a person.

Ex. The kindly woman helped the poor.

4. Given $f_{n+1} = f_n + f_{n-1}$. If $f_6 = 37$, $f_7 = 60$ then find f_1.

A. 4
B. 5
C. 8
D. 9

[MCQ - 1 Marks]

Ans. A

Sol. $f_{n+1} = f_n + f_{n-1}$

$f_{n-1} = f_{n+1} - f_n$

$n = 6 \quad f_5 = f_7 - f_6 = 60 - 37 = 23$

$n = 5 \quad f_4 = f_6 - f_5 = 37 - 23 = 14$

$n = 4 \quad f_3 = f_5 - f_4 = 23 - 14 = 9$

$n = 3 \quad f_2 = f_3 - f_3 = 14 - 9 = 5$

$n = 2 \quad f_1 = f_3 - f_2 = 9 - 5 = 4$

Section – B (Technical)

5. What does arity means?

A. Number of entries in the table
B. Number of samples in the table
C. Number of attribute in the table
D. Number of records in the table

[MCQ - 1 Mark]

Ans. C

Sol. Arity refers to the number of columns in a table.

For example, If a relation has 6 attributes say R(A, B, C, D, E, F) then the arity is 6.

6. Total number of tuples returned by below query:

Query: Select * from student where age > 65 and gender = 'F';

Student Table:

Roll No.	Name	Gender	Marks
1	A	M	65
2	B	F	70
3	B	F	80
4	C	M	82
5	D	F	65

[NAT - 2 Marks]

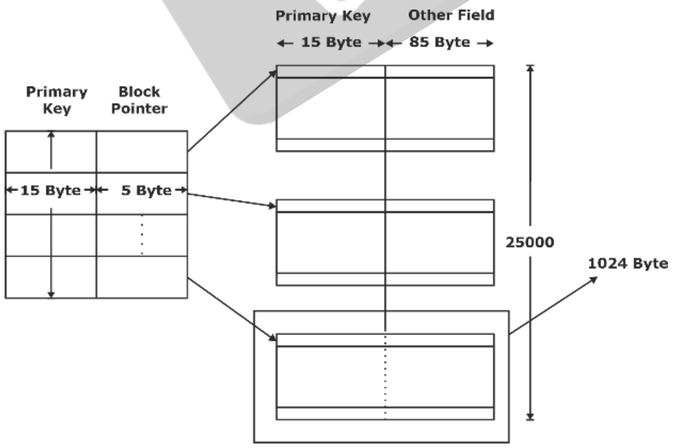
Ans. 2

Sol. The above query finds the total tuples (records)of female students who are elder than 65 in age.

Roll No.	Name	Gender	Marks
1	A	M	65
2	B	F	70
3	B	F	80
4	C	M	82
5	D	F	65

2 Tuples Selected

7. Total number of records are 25000,
Block size is 1024 Byte,
Key size = 15 Byte,
Block pointer Size = 5 Byte,
Total number of blocks required to access for a record using primary index?



[NAT - 2 Marks]

Ans. 7

Sol. Given,

Number of records = 25000

Block size = 1024 Byte

Key size = 15 Byte

Block pointer size = 5 Byte

Record size = 100 Byte

Index entry size = 15 + 5 = 20 Byte

Number of records per block $= \left\lfloor \frac{1024}{100} \right\rfloor$

$\lfloor 10.24 \rfloor = 10$

Total data blocks required $= \left\lceil \frac{25000}{10} \right\rceil$

= 2500

Number of index entries per block $= \left\lfloor \frac{1024}{20} \right\rfloor = \lfloor 51.2 \rfloor$

= 51

Total index blocks required $= \left\lceil \frac{\text{Total data blocks}}{\text{Total index entries}} \right\rceil = \left\lceil \frac{2500}{51} \right\rceil = \lceil 49.01 \rceil$

= 50

Total blocks required to access for searching a record using primary key $\lceil \log_2 50 \rceil + 1$

($\therefore$ Records are sequential so binary search is used)

= 6 + 1

= 7

8. Consider the following statements

S_1: Front end of the compiler is independent to hardware.

S_2: Back end is specific to target hardware.

S_3: Back end is specific to programming language.

A. S_1 only
B. S_2 & S_3
C. S_3 only
D. S_1 & S_2 only

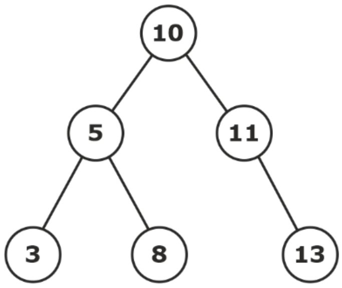
[MCQ - 1 Marks]

Ans. D

Sol. Front end of the compiler means the phases of the compiler completely depends on source language and independent on target machine.

Backend of the compiler means the phases of the compiler completely depends on the target machine and independent on source language.

9.



```
typedef struct mode {
int val;
struct node* left, *right;
} node

int foo (node *p)
{
int retval;
if (p ==Null)
return 0;
else
{
retval = p → val + foo (p → left) + foo (p
→ right);
printf ("%d", retval);
}
}
```

What is the output printed ?

A. 3, 8, 13, 16, 24, 50

B. 3, 8, 16, 13, 24, 50

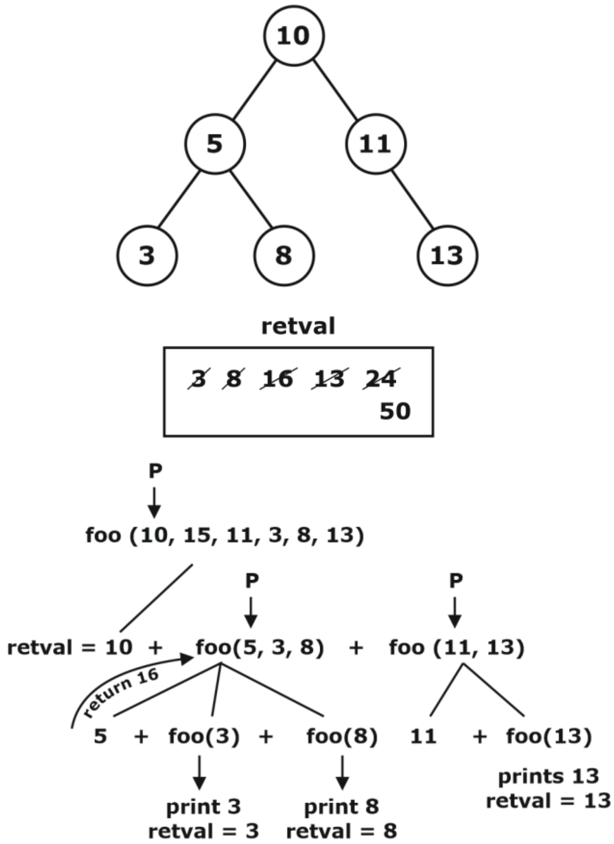
C. 3, 8, 16, 24, 13, 50

D. 3, 8, 16, 13, 24, 50

[MCQ - 2 Marks]

Ans. B

Sol.



foo(5, 3, 8) prints 16 retval = 16

foo (11, 13) prints 24 retval = 24

finally foo(10, 5, 11, 3, 8, 13) prints 10 + 16 + 24 = 60, retval = 50

Output: 3, 8, 16, 13, 24, 50

10. Which one of the following sequences when store in an array at locations A[1] to A[10] forms a max-heap?

A. 23, 14, 19, 1, 10, 13, 16, 12, 7, 5

B. 23, 17, 14, 7, 13, 10, 1, 5, 6, 12

C. 23, 17, 10, 6, 13, 14, 1, 5, 9, 12

D. 23, 17, 14, 6, 13, 10, 1, 5, 7, 15

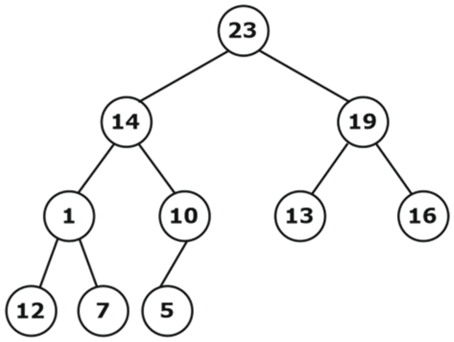
[MCQ - 1 Mark]

Ans. B

Sol. A max-heap must satisfy 2 properties

1. **Structuring property:** It must be a complete Binary Tree
2. **Ordering property:** Parent value must be greater than all children values at each level.

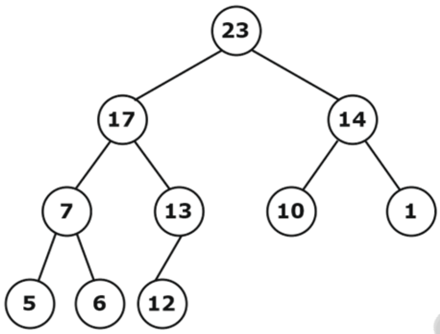
Option A:



Parent value 1 < children values 12, 7.

It's not max-heap.

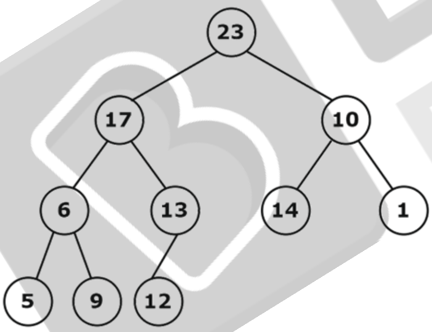
Option B :



It satisfy both properties.

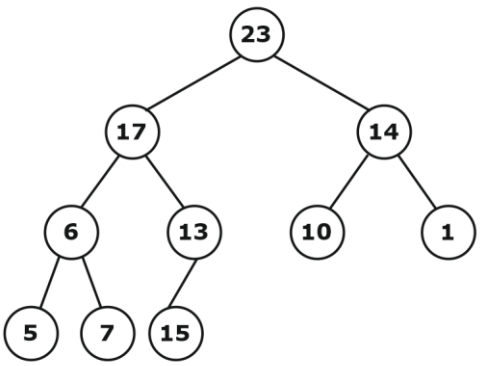
Hence, It is max-heap.

Option C:



6 < 9, Hence it is not max-heap.

Option D:



6 < 7 and 13 < 15.

Hence it's Not max-heap.

11.

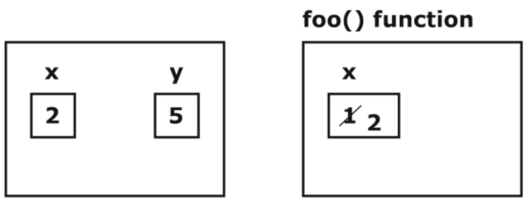
```
int foo ()
{
static int x = 1;
x++;
return (x);
}

main()
{
int x, y
x = foo();
y = foo() + x;
printf (x + y);
}
```

What is the output of above code ?

[NAT - 2 Marks]

Ans. 7

Sol. Program Execution starts from main() function.



x = foo() call foo function, initialise static variable x as 7. then x++ increments 'x' to 2 and return 2. Hence main() function's x = 2

y = foo() + x calls foo function again, Increment x to 3 and return 3.

y = 3 + 2 (main function x value) ⇒ y = 5

print (x + y) prints 7.

Answer is 7

12.

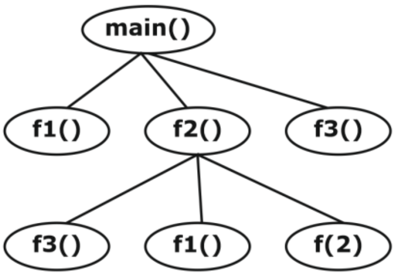
```
int main()
{
f1();
f2(2);
f3();
return 0;
}

int f1(){
x = 1;
return x;
}

int f2(x) {
f3();
if (x ==1){
return f1();
}
else {
return x – f2(x – 1);
}
f3(){
x = f
return x}
```

Activation tree of the function is ______.

[MCQ - 2 Marks]

Ans. *

Sol. Activation Tree of given code is :



Activation Tree root must be main() function, as Execution gets initiated from main() function. then all other function calls made in it will be represented as child nodes.

The functions, in which recursion is not happening, they are represented as Leaf nodes.

13. Which of the following will guarantee the computer system transition from user modes to kernel modes?

A. Page fault B. Malloc call

C. function call D. System call

[MSQ - 1 Mark]

Ans. A, D

Sol. a) **Page fault :** When a page fault occurs, required page must be loaded from secondary to main memory. means, RAM should be written. It will be done in privileged mode.

b) **Malloc () call:** It may be done in both user and kernel modes. Hence, It cannot guarantee switching.

c) **function call:** As the functions may be user defined, It also does not guarantee mode switching.

d) **System call :** System calls are executed (or) processed in kernel mode only. Hence, It guarantees mode switching.

14. Which of the following scheduling policies cause starvation ?

A. FIFO B. SJF

C. Priority D. RR

[MSQ - 1 Mark]

Ans. B, C

Sol. a) In FIFO policy, process may under go waiting but it is due to convoy effect.

b) In SJF, when short jobs keep arriving, then a longer job might need to wait for longer time. Hence, It could cause starvation.

c) Priority policy also may cause low priority processes to wait. So, starvation possible.

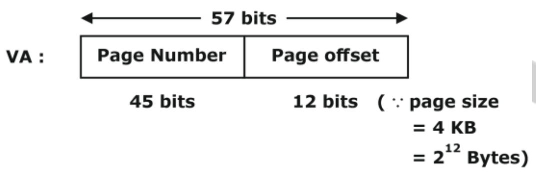
d) In round robin, as CPU time is shared to all processes, no process starve.

15. Consider a computer system with 57 bit virtual address using multilevel page tables with L levels for virtual to Physical address translation. The page size is 4 KB and page table entry at any of the levels occupy 8 bytes. What is the value of L ?

[NAT - 2 Marks]

Ans. 5

Sol.



- Page table size
  = No. of PTE's * PTE size
  = 2^{45} * 8 bytes = 2^{48} bytes ...(1)
- To store 2^{48} bytes page table, No. of pages required = $\frac{2^{48}B}{2^{12}B} = 2^{36}$
  2^{36} pages, page table size
  = 2^{36} PTE's * 8 bytes
  = 2^{39} bytes ...(2)
- To store 2^{39} bytes table, page required
  = $\frac{2^{39}\text{bytes}}{2^{12}\text{bytes}} = 2^{27}$
  2^{27} pages, page table size
  = 227 PTE's * 8 bytes
  = 230 bytes ...(3)
- 2^{30} bytes table is divided into
  $\frac{2^{30}}{2^{12}} = 2^{18}$Pages.
- 2^{18} pages, page table size = 2^{18} PTE's * 8 bytes = 2^{21} bytes ...(4)
- 2^{21} bytes table is divided into
  $\frac{2^{21}}{2^{12}} = 2^{9}$ pages.
  2^{9} pages, page table size = 29 * 8 bytes = 2^{12} bytes ...(5)

Hence, It can be stored in one frame of main memory.

So, number of levels of paging, L = 5

16. What need to be stored during context switch of threads (T_1) to (T_2)

A. PC

B. Stack register

C. General purpose register

D. Base address of table

[MSQ - 1 Mark]

Ans. A,B,C

Sol. While switching from one thread to another, program counter value, stack register value and GPR values for local variables are stored in memory. Base address will not stored in memory.

17. 8-way set associative cache of bytes, 64 KB (1 KB = 1024 bytes) is used in a system with 32 bit address. the address is sub divided into TAG, INDEX and BLOCK OFFSET. No. of bits in TAG is _______ ?

[NAT - 1 Mark]

Ans. 19 bits

Sol. Cache size = 64 KB = 2^{16} bytes

8-way set associative memory contains eight blocks per set.

Let us assume direct mapping is considered then,

Number of bits of TAG is set-associative mapping is more than direct mapping. For 2^n-way set associative, it is n-bits more. So for 8-way set associative, it is 3-bits more.

Total = 16 + 3 = 19 bits

18. 3 Stage pipelined processor having a delay of 10 ns, 20 ns, 14 ns, for the 1st, 2nd and 3rd stages respectively. No other delay and no other hazards. Assume 1 instruction is fetched in every cycle. The total execution time for 100 instruction is ________ ns.

[NAT - 2 Marks]

Ans. 2040 ns

Sol. Each cycle has max(10, 20, 14) ns which is 20 n.s.

Total cycles = (k + n – 1) × 1 cycle

Here K = 3 [Number of stages]

n = Number of instruction

Here n = 100, 1 cycle = 20 ns

Total cycles = (3 + 100 – 1) × 20 ns

= 102 × 20

= 2040 ns

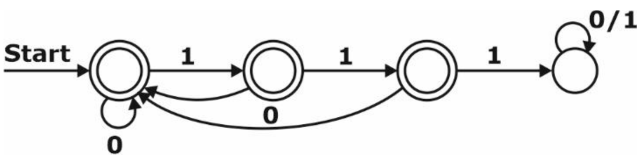
19. Minimum number of states in DFA which do not accept 111 sequence.

[NAT - 2 Marks]

Ans. 4

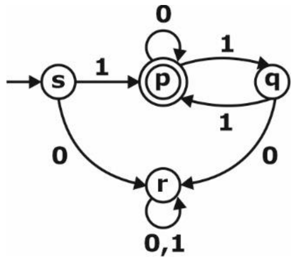
Sol. Assume S = {0, 1}

String do not contain 111 sequence,



Total states = 4 maximum

20. Consider the DFA below.



A. 1(0*11)* B. 1(0 + 11)*

C. 0(0 + 1)* D. 1(110*)*

[MCQ - 2 Marks]

Ans. B

Sol. **Option A:** 1(0*11)*, In this expression strings link "1110" not possible.

Option C: It generates strings link, 0, 01, 010, 0110, …., which are not accepted by DFA.

Option D: 1(110*)*, Here we don't get strings like 1011 …….

21. Which is true?

A. Recursive language ∩ Recursive language = Recursive language

B. Regular ∩ Regular = Regular

C. REL ∩ REL = REL

D. CFL ∩ CFL = CFL

[MSQ - 1 Mark]

Ans. A, B, C

Sol.
- Recursive languages are closed under complementation.
- Regular languages are closed under intersection and every regular is also recursive.
- R.E languages are also closed under complementation.
- CFL's are NOT closed under intersection.

So, A, B and C are true.

22. Regular expression: Letter (Letter|Digit)* What will be the NFA?

[MCQ - 1 Marks]

Ans. ?

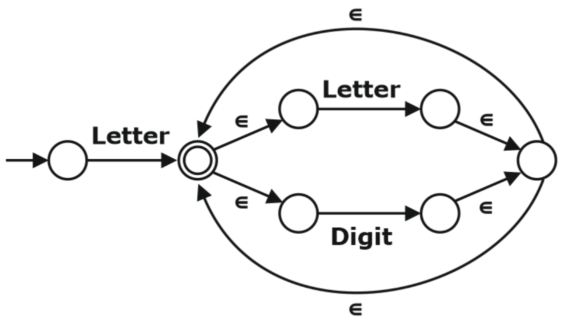
Sol. This expression covers all the strings starts with letter and followed by any combinations of letters and digits.

L(L + D)*

L : Letters

D = Digits

NFA



23. What is the language of grammar?

$$\begin{pmatrix} s \rightarrow aSb \mid X \\ X \rightarrow aX \mid bX \mid a \mid b \end{pmatrix}$$

Ans. ?

Sol. $S \rightarrow aSb|X$

$X \rightarrow aX|Xb|a|b$

Starting from X, we can generate any combination of a's and b's.

$S \rightarrow aSb$ gives strings like aSb, aaSbb, …, etc. If S is replaced with X then it generates $\{a^n \times b^n | n \geq 1\}$

$$\underbrace{a^n(a+b)+b^n+(a+b)^+}$$
$$\downarrow$$

It is equivalent to $(a + b)^+$

24. The utilization of stop and wait protocol will be low if

A. If link length is high and transmission rate is low

B. If link length is low and transmission rate is low

C. If link length is high and transmission rate is high

D. If link length is low and transmission rate is high

[MCQ - 1 Marks]

Ans. C

Sol. • If link length is more, then the propagation time will be more, so that there will be more idle time for the sender, which can reduce the utilization as the utilization of stop and wait protocol is as follows.

• If transmission rate is high then the time for transmission is less and hence the sender sits idle after the fast transmission.

Utilization = h = $\frac{T_t}{T_t + 2 \times T_p}$

25. Which of the following is false about OSPF

A. It uses Dijkstra algorithm

B. It uses Bellman ford algorithm

C. It is hierarchical protocol

D. Inter domain routing

[MCQ - 2 Marks]

Ans. B, D

Sol. • Dijkstra algorithm is used to create a shortest path tree.

• Bellmen ford is not used in shortest path identification.

• OSPF supports hierarchical

• OSPF is an intra-domain routing, not inter-domain.

26. $F(x) = x^3 + 15x^2 - 33x - 36$

[MSQ - 1 Mark]

A. F(x) has local minima

B. F(x) does not have local minima

C. F(x) has local maxima

D. F(x) does not have local maxima

Ans. A, C

Sol. $F(x) = x^3 + 15x^2 - 33x - 36$

$F'(x) = 3x^2 + 30x - 33$

$F'(x) = 0 \Rightarrow x^2 + 10x - 11 = 0 \Rightarrow x = 1, -11.$

$F''(x) = 6x + 30$

At $x = 1$: $F''(1) = 36 > 0 \Rightarrow$ f has local minimum

At $x = -11$: $F''(-11) = -36 < 0 \Rightarrow$ has local maximum

$\therefore$ So, option A and C are true.

27. $\int_{-3}^{3}\int_{-2}^{2}\int_{-1}^{1}\left(4x^2y - z^3\right)dzdydx$

[NAT – 1 Mark]

Sol. $I = \int_{-3}^{3}\int_{-2}^{2}\int_{-1}^{1}\left(4x^2y - z^3\right)dzdydx$

$=$

$$\underbrace{\int_{-3}^{3}\int_{-2}^{2}\int_{-1}^{1} 4x^2y \; dzdydx}_{\downarrow \; y \text{ is odd function}} - \underbrace{\int_{-3}^{3}\int_{-2}^{2}\int_{-1}^{1} 2^3 \; dzdydx}_{\downarrow \; \text{odd function}}$$

So, integral is 0

So, integral is 0

$= 0 - 0 = 0$

28. $A = \begin{bmatrix} 1 & 2 & 3 & 4 \\ 4 & 1 & 2 & 3 \\ 3 & 4 & 1 & 2 \\ 2 & 3 & 4 & 1 \end{bmatrix}$ $B = \begin{bmatrix} 3 & 4 & 1 & 2 \\ 4 & 1 & 2 & 3 \\ 1 & 2 & 3 & 4 \\ 2 & 3 & 4 & 1 \end{bmatrix}$

[MCQ – 1 Mark]

A. $|A| = |B|$

B. $|AB| = |A| + |B|$

C. $|B| = -|A|$

D. $|A| = 0$

Ans. C

Sol. $A = \begin{bmatrix} 1 & 2 & 3 & 4 \\ 4 & 1 & 2 & 3 \\ 3 & 4 & 1 & 2 \\ 2 & 3 & 4 & 1 \end{bmatrix}$ $B = \begin{bmatrix} 3 & 4 & 1 & 2 \\ 4 & 1 & 2 & 3 \\ 1 & 2 & 3 & 4 \\ 2 & 3 & 4 & 1 \end{bmatrix}$

Clearly $\boxed{A}\ R_1 \leftrightarrow R_3\ \boxed{B}$

By determinant properties, $|A| = -|B|$ and $|B| = -|A|$

29. In an experiment, two fair coins are tossed. Let A be the event that denotes HEAD on both throw, B event denotes HEAD on first throw and C event denotes HEAD on second throw. Which of the following is/are true?

A. A and C are independent

B. B and C are independent

C. A and B are independent

D. P(B/C) = P(B)

[MCQ - 2 Marks]

Ans. B, D

Sol. Sample space, Ω = {HH, HT, TH, TT}

A = HH p(A) = $\frac{1}{4}$

B = H_ = HT or HH p(B) = $\frac{1}{4} + \frac{1}{4} = \frac{1}{2}$

C = _H = TH or HH p(c) = $\frac{1}{4} + \frac{1}{4} = \frac{1}{2}$

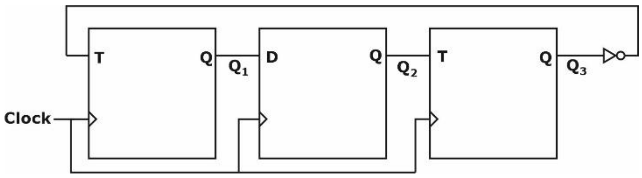
A & B $\Rightarrow$ HH

A & C $\Rightarrow$ HH

B & C $\Rightarrow$ HH

30. Consider the sequential circuit

Initially Q_1, Q_2, Q_3 = 0, 1, 1



Which state does not occur

A. 1, 1, 1

B. 1, 0, 0

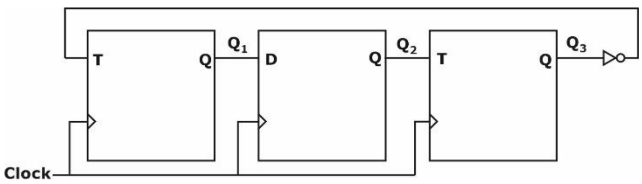
C. 1, 0, 1

D. 0, 0, 1

[MCQ - 2 Marks]

Ans. D

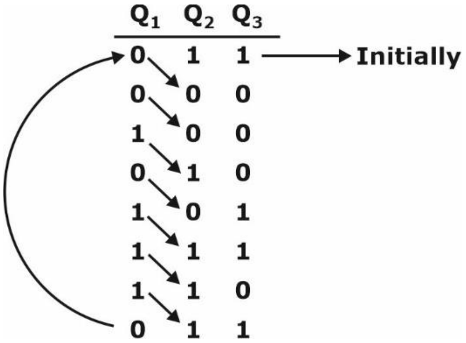
Sol. (0,0,1)



Note $Q_2^+ = D = Q_1$

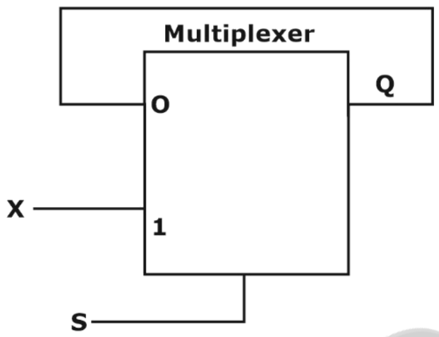
If $Q_3 = 0$ Toggle Q_1

If $Q_2 = 1$ Toggle Q_3



So, (0, 0, 1) does not occur

31. Find the function



A. D flip flop B. D latch

C. Half adder D. Demultiplexer

[MCQ - 1 Marks]

Ans. B

Sol. For S = O, $Q^+ = I_0 = Q_2$

For S = 1, $Q^+ = I_1 = X$

Let S = Clock and X = D

So, If clock = 1, $Q^+ = D$

If clock = 0, $Q^+ = Q$

So, it is a level triggered circuit, So it is D latch.

32. $(132)_4 = (?)_5$ then find the value in radix 5 ________.

[NAT - 1 Marks]

Ans. 110

Sol. $(132)_4 = (?)_5$

$(132)_4 = (?)_{10} = (?)_5$

$(132)_4 = 1 \times 4^2 + 3\times4^1 + 2 \times 4^0$

$= (30)_{10}$

$(30)_{10} = (?)_5$

	Q	R
30 / 5	6	0
6 / 5	1	1
1 / 5	0	1

Ans: $(110)_5$

33. $L_n = L_{n-1} + L_{n-2}$, $L_1 = 1$, $L_2 = 3$

[MCQ - 1 Mark]

A. $L_n = \left(\frac{1+\sqrt{5}}{2}\right)^n + \left(\frac{1-\sqrt{5}}{2}\right)^n$

B. $L_n = \left(\frac{1+\sqrt{5}}{2}\right)^n - \left(\frac{1-\sqrt{5}}{2}\right)^n$

C. $L_n = \left(\frac{1+\sqrt{5}}{2}\right)^n - \left(\frac{1-\sqrt{5}}{3}\right)^n$

D. $L_n = \left(\frac{1+\sqrt{5}}{2}\right)^n + \left(\frac{1-\sqrt{5}}{3}\right)^n$

Ans. A

Sol. $L_n - L_{n-1} - L_{n-2} = 0$

$t^2 - t - 1 = 0$

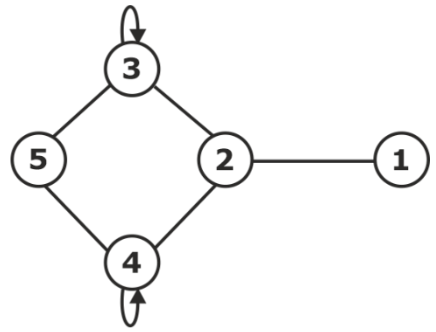
$t = \frac{1 \pm \sqrt{1+4}}{2} = \frac{1 \pm \sqrt{5}}{2}$ → option C and D are wrong.

Option A: $L_1 = \frac{1+\sqrt{5}}{2} + \frac{1-\sqrt{5}}{2} = 1$

Option B: $L_1 = \frac{1+\sqrt{5}}{2} - \frac{1+\sqrt{5}}{2} = \sqrt{5} \neq 1$

34. Consider this graph and it is represented by adjacency matrix. Let $\lambda_1, \lambda_2 \ldots \lambda_5$ are eigen values of A. Then $\lambda_1 + \lambda_2 + \lambda_3 + \lambda_4 + \lambda_5 =$

[NAT - 1 Mark]



Ans. 2

Sol. Adjacency matrix

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

Sum of eigen value $\lambda_1 + \lambda_2 + \lambda_3 + \lambda_4 + \lambda_5 = 2$

35. f: A - B is onto define equivalence relation $a_1 \sim a_2 \Leftrightarrow f(a_1) = f(a_2)$. Let E = {[x] x∈A} be the set of all equivalence classes. Define a new mapping F[[x]] = f(x). Then

[MSQ - 2 marks]

A. F is bijection

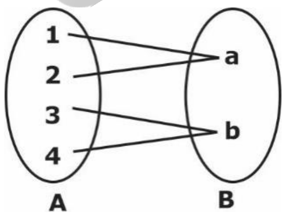
B. F is onto

C. F is not well defined

D. F is injective

Ans. A, B and D

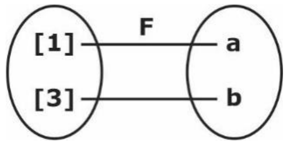
Sol. For example, Take A = {1, 2, 3, 4} B = {a, b}



So equivalence

Closer one {[1], [3]}

According, definition of F, F is as below



Clearly F is one-one, onto and hence bijection.

So, options A, B and D are true.

36. Let x be a set, 2^x = power 2k set of X. Define A binary operation Δ on 2^x as AΔB = (A - B) U (B - A). Let H = (2^x, Δ), then

[MSQ - 2 marks]

A. H satisfies inverse property but not a group

B. For every A ϵ 2^x, inverse of $\overline{A}$ is A

C. For every A ϵ 2^x, inverse of A is $\overline{A}$

D. H is a group

Ans. B and D

Sol. x-set 2^x - power set of x

(2x – Δ) Algebraic structure

1. Identity property

   φ is identity element since

   AΔφ = A = φΔA

2. Inverse property

   Clearly for each A,

   AΔA = φ = AΔA

   So, A is inverse of A

Hence, (2^x – Δ) is a group

∴ Option B and D are true

37. G is simple finite undirected graph with {$V_1, V_2, \ldots V_n$} N = {1, 2,....n} where Δ(G) is the minimum degree. Consider the greedy strategy for i = 1, 2……n color (Vi) = min{j ϵ N/no neighbour of Vi is colored j}

[MSQ – 2 Marks]

A. Number of colors used is chromatic number

B. Number of colors used is atmost $\Delta(G) + 1$

C. Number of colors used is atmost $\Delta(G)$

D. This procedure is result in proper vertex coloring

Ans. A, B and D

Sol. The given procedure is to do vertex during of a graph.

So, number of colors used is chromatic number.

By chromatic number properties,

No. of colors used is atmost $\Delta(G) + 1$

∴ Option A, B and D are true.

38. Let f & g is function of natural number $f(n) = n$ and $g(n) = n^2$ then which statement is true

[MCQ – 1 Mark]

A. $f \in \Omega(g)$ B. $f \in O(g)$

C. $f \in \theta(g)$ D. $f \in o(g)$

Ans. B and D

Sol. A. $\Omega(g(n)) = \Omega(n^2)$ set of all functions which are asymptotically $\geq n^2$

B. $O(g(n)) = O(n^2)$ set of all functions which are asymptotically $\leq n^2$

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

C. $\theta(g(n)) = \theta(n^2)$ set of all functions which are asymptotically $\approx n^2$

D. $o(g(n)) = o(n^2)$ set of all functions which are asymptotically $< n^2$

$f = o(g(n))$ is true

39. Geetha has a conjecture about integers which is of the form $\forall x\, [P(x) \Rightarrow \exists y Q(x, y)]$, where P is a statement about integers and Q is a statement about pairs of integers. Which of the following (one or more) option would imply Geetha's conjecture.

[MSQ, 2 Marks]

A. $\exists x[P(x) \wedge \forall y\, Q(x, y)$

B. $\exists x[P(x) \wedge \exists y\, Q(x, y)$

C. $\exists y\, \forall x[P(x) \Rightarrow Q(x, y)$

D. $\forall x\, \forall y\, Q(x, y)$

Ans. C and D

Sol. Option C: $\exists y\, \forall x[P(x) \Rightarrow Q(x, y)]$

Use the rule $\exists y\, \forall x\, A(x, y) \Rightarrow \forall x\, \exists y\, A(x, y)$

So, option C implied $\forall x[P(x) \Rightarrow \exists y\, Q(x, y)]$

Option D: $\forall x\, \forall y\, Q(x, y)$

$\forall x\, \forall y\, Q(x, y)$ is true

$\Rightarrow \forall x\, \forall y\, P(x) \Rightarrow Q(x, y)$ is true

$\Rightarrow \forall x\, [P(x) \Rightarrow \exists y\, 2(x, y)]$ is true

40. Consider the following Pseudo code.

Fun. 1	Fun. 2
While n > 1 do	for i = 1 to 100n do
for i = 1 to n	x = x + 1
x = x + 1	end for
end for	
$n = \left\lfloor \frac{n}{2} \right\rfloor$	
end while	

[MSQ – 2 Marks]

A. $f_1 \in O(f_2)$ B. $f_1 \in \theta(f_2)$

C. $f_1 \in \omega(f_2)$ D. $f_1 \in o(f_2)$

Ans. C

Sol. Option A: $O(f_2) = O(n)$ set of all functions which are asymptotically $\leq n$.

$f_1 = \theta\,(f_2)$ is false.

Option B: $\theta(f_2) = \theta(n)$ set of all function which are asymptotically $\approx n$

$f_1 = \theta(f_2)$ is false

Option C: $\omega(f_2) = \omega(n)$ = set of all function which are asymptotically > n

$f_1 = \omega(f_2(n))$ true

$o(f_2) = o(n)$ = set of all functions which are < n

$f_1 = 0(f_2)$ is true

41. A priority queue, implementation using max heap. Extract-max (A) = Extract and delete the max elements, Insert (A, key) - Insert-key in A. Then, [Note: properties of heap should be maintained at end of each operation].

[MCQ – 1 Mark]

A. O(logn), O(logn)

B. O(1), O(n)

C. O(1), O(logn)

D. O(1), O(1)

Ans. A

Sol. Extract-max (A): swap root element with last element and max heapify (root) → O(logn)

Insert (A, key): Insert and Heaping taken → O(logn)

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GATE 2023 CS & IT Engg. : Expected Topper’s Marks

- 80+/100 Marks Expected for AIR under 10
- 75+/100 Marks Expected for AIR under 100

GATE 2023 CS Expected Cut-Off

Category	2021	2022	Expected 2023
General	26.1	25	25 to 26
OBC	23.4	22.5	23
SC/ST	17.4	16.6	18

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100+ Students under AIR-100 2021


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Rank 03
Manoj (EC)


Rank 03
Munish (ME)


Rank 06
Parag (EC)


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Vatsal (ME)


Rank 08
Rahul (CE)


Rank 08
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Rank 08
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Vamsi (EC)


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Shashwat (CE)

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Rank 09
Avinash (ME)


Rank 09
Himanshu (EE)


Rank 26
Kartikay (CE)


Rank 30
Raja (EC)


Rank 39
Akash Singh (CS)


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Navneet (CS)


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Rishi (EE)


Rank 56
Apurv Mittal (ME)


Rank 56
Nikhil (ME)

Our Success Stories

Our Outstanding GATE Results

80+

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Rank 02
Vandit (EE)


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Parvinder (ME)


Rank 06
Abhishek (ME)


Rank 06
Vivek (CE)


Rank 08
Kiran (CS)


Rank 09
Shivam (EC)


Rank 09
Tushar (EE)


Rank 10
Mitesh (CS)


Rank 11
Kaustav (ME)


Rank 11
Souvik (ME)


Rank 12
Himanshu (CE)


Rank 15
Surya (CS)


Rank 18
Swastik (CE)


Rank 20
Lakshay (ME)


Rank 21
Tathagata (CS)


Rank 22
Ayush (CE)


Rank 29
Piyush (EE)


Rank 38
Rajat (EE)