

GATE CS 2016 SET-1

EE25BTECH11052 - Shriyansh Chawda

Q.1 - Q.5 Carry ONE mark each

- 1) Out of the following four sentences, select the most suitable sentence with respect to grammar and usage. (GATE CS 2016)
- a) I will not leave the place until the minister does. I will not leave the place until the minister meet not meet me.
 b) I will not leave the place until the ministered. I will not leave the place until the minister meets doesn't meet me. me.
- 2) A rewording of something written or spoken is a _____. (GATE CS 2016)
- a) paraphrase b) paradox c) paradigm d) paraffin
- 3) Archimedes said, "Give me a lever long enough and a fulcrum on which to place it, and I will move the world." The sentence above is an example of a _____ statement. (GATE CS 2016)
- a) figurative b) collateral c) literal d) figurine
- 4) If 'relftaga' means carefree, 'otaga' means careful and 'fertaga' means careless, which of the following could mean 'aftercare'? (GATE CS 2016)
- a) zentaga b) tagafer c) tagazen d) relffer
- 5) A cube is built using 64 cubic blocks of side one unit. After it is built, one cubic block is removed from every corner of the cube. The resulting surface area of the body (in square units) after the removal is _____. (GATE CS 2016)
- a) 56 b) 64 c) 72 d) 96
- 6) A shaving set company sells 4 different types of razors, Elegance, Smooth, Soft and Executive. Elegance sells at Rs. 48, Smooth at Rs. 63, Soft at Rs. 78 and Executive at Rs. 173 per piece. The table below shows the numbers of each razor sold in each quarter of a year.

Quarter \Product	Elegance	Smooth	Soft	Executive
Q1	27300	20009	17602	9999
Q2	25222	19392	18445	8942
Q3	28976	22429	19544	10234
Q4	21012	18229	16595	10109

Which product contributes the greatest fraction to the revenue of the company in that year?

(GATE CS 2016)

Q. 1 - Q. 25 carry one mark each

1) Let p, q, r, s represent the following propositions.

- p : $x \in \{8, 9, 10, 11, 12\}$
 q : x is a composite number
 r : x is a perfect square
 s : x is a prime number

The integer $x \geq 2$ which satisfies $\neg((p \Rightarrow q) \wedge (\neg r \vee \neg s))$ is _____.

(GATE CS 2016)

2) Let a_n be the number of n -bit strings that do NOT contain two consecutive 1s. Which one of the following is the recurrence relation for a_n ?

(GATE CS 2016)

- a) $a_n = a_{n-1} + 2a_{n-2}$ c) $a_n = 2a_{n-1} + a_{n-2}$
 b) $a_n = a_{n-1} + a_{n-2}$ d) $a_n = 2a_{n-1} + 2a_{n-2}$

3) $\lim_{x \rightarrow 4} \frac{\sin(x-4)}{x-4} = \underline{\hspace{2cm}}$.

(GATE CS 2016)

4) A probability density function on the interval $[a, 1]$ is given by $1/x^2$ and outside this interval the value of the function is zero. The value of a is _____.

(GATE CS 2016)

5) Two eigenvalues of a 3×3 real matrix P are $(2 + \sqrt{-1})$ and 3. The determinant of P is _____.

(GATE CS 2016)

6) Consider the Boolean operator $\#$ with the following properties: $x\#0 = x$, $x\#1 = \bar{x}$, $x\#x = 0$ and $x\#\bar{x} = 1$. Then $x\#y$ is equivalent to

(GATE CS 2016)

- a) $x\bar{y} + \bar{x}y$ b) $x\bar{y} + \bar{x}\bar{y}$ c) $\bar{x}y + xy$ d) $xy + \bar{x}\bar{y}$

7) The 16-bit 2's complement representation of an integer is 1111 1111 1111 0101; its decimal representation is _____.

(GATE CS 2016)

8) We want to design a synchronous counter that counts the sequence 0-1-0-2-0-3 and then repeats. The minimum number of J-K flip-flops required to implement this counter is _____.

(GATE CS 2016)

9) A processor can support a maximum memory of 4 GB, where the memory is word-addressable (a word consists of two bytes). The size of the address bus of the processor is at least _____ bits.

(GATE CS 2016)

10) A queue is implemented using an array such that ENQUEUE and DEQUEUE operations are performed efficiently. Which one of the following statements is CORRECT (n refers to the number of items in the queue)?

(GATE CS 2016)

- a) Both operations can be performed in $O(1)$ time
 b) At most one operation can be performed in $O(1)$ time but the worst case time for the other operation will be $\Omega(n)$
 c) The worst case time complexity for both operations will be $\Omega(n)$
 d) Worst case time complexity for both operations will be $\Omega(\log n)$

11) Consider the following directed graph:

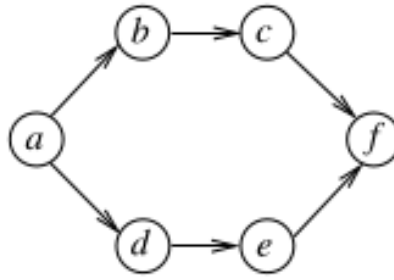


Fig. 1

The number of different topological orderings of the vertices of the graph is _____.
(GATE CS 2016)

12) Consider the following C program.

```

void f(int, short);
void main()
{
    int i = 100;
    short s = 12;
    short *p = &s;
    _____ ; // call to f()
}
  
```

Which one of the following expressions, when placed in the blank above, will NOT result in a type checking error?

(GATE CS 2016)

- a) $f(s, *s)$ b) $i = f(i, s)$ c) $f(i, *s)$ d) $f(i, *p)$

13) The worst case running times of Insertion sort, Merge sort and Quick sort, respectively, are:

(GATE CS 2016)

- a) $\Theta(n \log n)$, $\Theta(n \log n)$, and $\Theta(n^2)$ c) $\Theta(n^2)$, $\Theta(n \log n)$, and $\Theta(n \log n)$
 b) $\Theta(n^2)$, $\Theta(n^2)$, and $\Theta(n \log n)$ d) $\Theta(n^2)$, $\Theta(n \log n)$, and $\Theta(n^2)$

14) Let G be a weighted connected undirected graph with distinct positive edge weights. If every edge weight is increased by the same value, then which of the following statements is/are TRUE?

P : Minimum spanning tree of G does not change

Q : Shortest path between any pair of vertices does not change

(GATE CS 2016)

- a) P only b) Q only c) Neither P nor Q d) Both P and Q

15) Consider the following C program.

```

#include<stdio.h>
void mystery(int *ptr a, int *ptr b) {
    int *temp;
    temp = ptr b;
}
  
```

```

ptrb = ptra;
ptra = temp;
}
int main() {
    int a=2016, b=0, c=4, d=42;
    mystery(&a, &b);
    if (a < c)
        mystery(&c, &a);
    mystery(&a, &d);
    printf("%d\n", a);
}

```

The output of the program is _____.

(GATE CS 2016)

16) Which of the following languages is generated by the given grammar?

$$S \rightarrow aS \mid bS \mid \varepsilon$$

(GATE CS 2016)

- a) $\{a^n b^m \mid n, m \geq 0\}$
- b) $\{w \in \{a, b\}^* \mid w \text{ has equal number of a's and b's}\}$
- c) $\{a^n \mid n \geq 0\} \cup \{b^n \mid n \geq 0\} \cup \{a^n b^n \mid n \geq 0\}$
- d) $\{a, b\}^*$

17) Which of the following decision problems are undecidable?

- a) Given NFAs N_1 and N_2 , is $L(N_1) \cap L(N_2) = \Phi$?
- b) Given a CFG $G = (N, \Sigma, P, S)$ and a string $x \in \Sigma^*$, does $x \in L(G)$?
- c) Given CFGs G_1 and G_2 , is $L(G_1) = L(G_2)$?
- d) Given a TM M , is $L(M) = \Phi$?

(GATE CS 2016)

- a) I and IV only
- b) II and III only
- c) III and IV only
- d) II and IV only

18) Which one of the following regular expressions represents the language: the set of all binary strings having two consecutive 0s and two consecutive 1s?

(GATE CS 2016)

- a) $(0 + 1)^* 0011 (0 + 1)^* + (0 + 1)^* 1100 (0 + 1)^*$
- b) $(0 + 1)^* (00 (0 + 1)^* 11 + 11 (0 + 1)^* 00) (0 + 1)^*$
- c) $(0 + 1)^* 00 (0 + 1)^* + (0 + 1)^* 11 (0 + 1)^*$
- d) $00 (0 + 1)^* 11 + 11 (0 + 1)^* 00$

19) Consider the following code segment.

```

x = u - t;
y = x * v;
x = y + w;
y = t - z;
y = x * y;

```

The minimum number of total variables required to convert the above code segment to static single assignment form is _____.

(GATE CS 2016)

- 20) Consider an arbitrary set of CPU-bound processes with unequal CPU burst lengths submitted at the same time to a computer system. Which one of the following process scheduling algorithms would minimize the average waiting time in the ready queue?

(GATE CS 2016)

- a) Shortest remaining time first
- b) Round-robin with time quantum less than the shortest CPU burst
- c) Uniform random
- d) Highest priority first with priority proportional to CPU burst length

- 21) Which of the following is NOT a superkey in a relational schema with attributes V, W, X, Y, Z and primary key VY ?

(GATE CS 2016)

- a) $VXYZ$
- b) $VWXZ$
- c) $VWXY$
- d) $VWXYZ$

- 22) Which one of the following is NOT a part of the ACID properties of database transactions?

(GATE CS 2016)

- a) Atomicity
- b) Consistency
- c) Isolation
- d) Deadlock-freedom

- 23) A database of research articles in a journal uses the following schema. ($VOLUME, NUMBER, STARTPAGE, ENDPAGE, TITLE, YEAR, PRICE$). The primary key is ($VOLUME, NUMBER, STARTPAGE, ENDPAGE$) and the following functional dependencies exist in the schema.

$(VOLUME, NUMBER, STARTPAGE, ENDPAGE) \rightarrow TITLE$

$(VOLUME, NUMBER) \rightarrow YEAR$

$(VOLUME, NUMBER, STARTPAGE, ENDPAGE) \rightarrow PRICE$

The database is redesigned to use the following schemas.

$(VOLUME, NUMBER, STARTPAGE, ENDPAGE, TITLE, PRICE)$

$(VOLUME, NUMBER, YEAR)$

Which is the weakest normal form that the new database satisfies, but the old one does not?

(GATE CS 2016)

- a) 1NF
- b) 2NF
- c) 3NF
- d) BCNF

- 24) Which one of the following protocols is NOT used to resolve one form of address to another one?

(GATE CS 2016)

- a) DNS
- b) ARP
- c) DHCP
- d) RARP

- 25) Which of the following is/are example(s) of stateful application layer protocols?

- a) HTTP
- b) FTP
- c) TCP
- d) POP3

(GATE CS 2016)

- a) (i) and (ii) only
- b) (ii) and (iii) only
- c) (ii) and (iv) only
- d) (iv) only

- 26) The coefficient of x^{12} in $(x^3 + x^4 + x^5 + x^6 + \dots)^3$ is _____.

(GATE CS 2016)

27) Consider the recurrence relation $a_1 = 8$, $a_n = 6n^2 + 2n + a_{n-1}$. Let $a_{99} = K \times 10^4$. The value of K is _____.

(GATE CS 2016)

28) A function $f: \mathbb{N}^+ \rightarrow \mathbb{N}^+$, defined on the set of positive integers \mathbb{N}^+ , satisfies the following properties:

$$f(n) = f(n/2) \text{ if } n \text{ is even}$$

$$f(n) = f(n+5) \text{ if } n \text{ is odd}$$

Let $R = \{i \mid \exists j: f(j) = i\}$ be the set of distinct values that f takes. The maximum possible size of R is _____.

(GATE CS 2016)

29) Consider the following experiment.

Step 1. Flip a fair coin twice.

Step 2. If the outcomes are (TAILS, HEADS) then output Y and stop.

Step 3. If the outcomes are either (HEADS, HEADS) or (HEADS, TAILS), then output N and stop.

Step 4. If the outcomes are (TAILS, TAILS), then go to Step 1.

The probability that the output of the experiment is Y is (up to two decimal places) _____.

(GATE CS 2016)

30) Consider the two cascaded 2-to-1 multiplexers as shown in the figure.

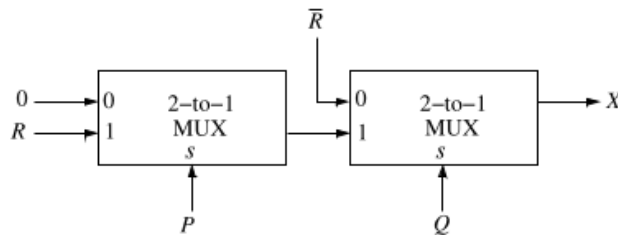


Fig. 2

The minimal sum of products form of the output X is

(GATE CS 2016)

- a) $\bar{P}\bar{Q} + PQR$ b) $\bar{P}Q + QR$ c) $PQ + \bar{P}\bar{Q}R$ d) $\bar{Q}\bar{R} + PQR$

31) The size of the data count register of a DMA controller is 16 bits. The processor needs to transfer a file of 29,154 kilobytes from disk to main memory. The memory is byte addressable. The minimum number of times the DMA controller needs to get the control of the system bus from the processor to transfer the file from the disk to main memory is _____.

(GATE CS 2016)

32) The stage delays in a 4-stage pipeline are 800, 500, 400 and 300 picoseconds. The first stage (with delay 800 picoseconds) is replaced with a functionally equivalent design involving two stages with respective delays 600 and 350 picoseconds. The throughput increase of the pipeline is _____ percent.

(GATE CS 2016)

33) Consider a carry lookahead adder for adding two n -bit integers, built using gates of fan-in at most two. The time to perform addition using this adder is

(GATE CS 2016)

- a) $\Theta(1)$ b) $\Theta(\log(n))$ c) $\Theta(\sqrt{n})$ d) $\Theta(n)$

34) The following function computes the maximum value contained in an integer array $p[]$ of size n ($n \geq 1$).

```
int max(int *p, int n) {
    int a=0, b=n-1;
    while (_____) {
        if (p[a] <= p[b]) { a = a+1; }
        else { b = b-1; }
    }
    return p[a];
}
```

The missing loop condition is

(GATE CS 2016)

- a) $a \neq n$ b) $b \neq 0$ c) $b > (a + 1)$ d) $b \neq a$

35) What will be the output of the following C program?

```
void count(int n){
    static int d=1;
    printf("%d ", n);
    printf("%d ", d);
    d++;
    if(n>1) count(n-1);
    printf("%d ", d);
}
void main(){
    count(3);
}
```

(GATE CS 2016)

- a) 3 1 2 2 1 3 4 4 4 c) 3 1 2 2 1 3 4
b) 3 1 2 1 1 1 2 2 2 d) 3 1 2 1 1 1 2

36) What will be the output of the following pseudo-code when parameters are passed by reference and dynamic scoping is assumed?

```
a=3;
void n(x) {x = x * a; print(x);}
void m(y) {a = 1; a = y - a; n(a); print(a);}
void main() {m(a);}
```

(GATE CS 2016)

- a) 6, 2 b) 6, 6 c) 4, 2 d) 4, 4

37) An operator $\text{delete}(i)$ for a binary heap data structure is to be designed to delete the item in the i -th node. Assume that the heap is implemented in an array and i refers to the i -th index of the array. If the heap tree has depth d (number of edges on the path from the root to the farthest leaf), then what is the time complexity to re-fix the heap efficiently after the removal of the element?

(GATE CS 2016)

- $O(1)$
- $O(d)$ but not $O(1)$

- c) $O(2^d)$ but not $O(d)$
d) $O(d \cdot 2^d)$ but not $O(2^d)$

38) Consider the weighted undirected graph with 4 vertices, where the weight of edge $\{i, j\}$ is given by the entry W_{ij} in the matrix W .

$$W = \begin{pmatrix} 0 & 2 & 8 & 5 \\ 2 & 0 & 5 & 8 \\ 8 & 5 & 0 & x \\ 5 & 8 & x & 0 \end{pmatrix}$$

The largest possible integer value of x , for which at least one shortest path between some pair of vertices will contain the edge with weight x is _____.

(GATE CS 2016)

39) Let G be a complete undirected graph on 4 vertices, having 6 edges with weights being 1, 2, 3, 4, 5, and 6. The maximum possible weight that a minimum weight spanning tree of G can have is _____.

(GATE CS 2016)

40) $G = (V, E)$ is an undirected simple graph in which each edge has a distinct weight, and e is a particular edge of G . Which of the following statements about the minimum spanning trees (MSTs) of G is/are TRUE?

- If e is the lightest edge of some cycle in G , then every MST of G includes e
- If e is the heaviest edge of some cycle in G , then every MST of