Solutions of

of

Computer Science & IT

GATE-2016

Session 5 | Set-1

MADE EASY

India's Best Institute for IES, GATE & PSUs

Write us at info@madeeasy.in | Phone: 011-45124612, 9958995830

www.madeeasy.in

MADE EASY

MADE EASY

India's Best Institute for IES, GATE & PSUs

GATE 2016 : Solutions

Dear students,

MADE EASY team has tried to provide the best possible/closest answers, however if you find any discrepancy then write your doubts to MADE EASY at: *info@madeeasy.in.* MADE EASY owes no responsibility for any kind of error due to data insufficiency/misprint/human errors etc.

***B. Singh (Ex. IES),** Chairman & Managing Director, MADE EASY Group*

Rewards & Honours

MADE EASY will honour its GATE 2016: Top-100 Rankers

AIR 1 Gold Medal + Car

AIR 2 Gold Medal + Bike

AIR 3 Gold Medal + Laptop

AIR 4 Silver Medal + Tab

AIR 11-100 Bronze Medal + Prize

GATE-2016 aspirants who have taken guidance from MADE EASY (Classroom, Postal, Test Series in current session or previous sessions) are requested to inform us about your result and avail free Interview & Counseling Guidance for M.Tech & PSUs.

For more details, visit: **www.madeeasy.in**

MADE EASY Centres

DELHI	NOIDA	LUCKNOW	JAIPUR	BHOPAL	INDORE	PUNE	HYDERABAD	BHUBANESWAR	KOLKATA	Patna
011-45124612	0120-6524612	09919111168	0141-4024612	0755-4004612	0731-4029612	020-26058612	040-66774612	0674-6999888	033-68888880	09955991166

Section - I (General Aptitude)

One Mark Questions

Q.1 Out of the following four sentences, select the most suitable sentence with respect to grammar and usage.

(a) I will not leave the place until the minister does not meet me.
(b) I will not leave the place until the minister doesn't meet me.
(c) I will not leave the place until the minister meet me.
(d) I will not leave the place until the minister meets me.

Ans. **(d)**

End of Solution

Q.2 A rewording of something written or spoken is a ____________.

(a) paraphrase (b) paradox
(c) paradigm (d) paraffin

Ans. **(a)**

End of Solution

Q.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.

(a) figurative (b) collateral
(c) literal (d) figurine

Ans. **(a)**

End of Solution

Q.4 If 'relftaga' means carefree, 'otaga' means careful and 'fertaga' means careless, which of the following could mean 'aftercare'?

(a) zentaga (b) tagafer
(c) tagazen (d) relffer

Ans. **(c)**

End of Solution

Q.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 _________.

(a) 56 (b) 64
(c) 72 (d) 96

Ans. **(d)**

Original surface area = $6(4)^2 = 96$

If corner cubes are removed, three exposed surfaces are removed which will create 3 new surfaces in original large cube. So surface area will remain unchanged, i.e. 96

End of Solution

Two Marks Questions

Q.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?

(a) Elegance
(b) Executive
(c) Smooth
(d) Soft

Ans. **(b)**

Elegance (27300 + 25222 + 28976 + 21012) × 48 = A

Executive (999 + 8942 + 10234 + 10234 + 10109) × 173 = B

Smooth (20009 + 9392 + 22429 + 18229) × 63 = C

Soft (17602 +18445 + 19544 + 16595) × 78 = D

Which is highest for B (executive).

End of Solution

Q.7 Indian currency notes show the denomination indicated in at least seventeen languages. If this is not an indication of the nation's diversity, nothing else is.
Which of the following can be logically inferred from the above sentences?

(a) India is a country of exactly seventeen languages.
(b) Linguistic pluralism is the only indicator of a nation's diversity.
(c) Indian currency notes have sufficient space for all the Indian languages.
(d) Linguistic pluralism is strong evidence of India's diversity.

Ans. **(d)**

End of Solution

Q.8 Consider the following statements relating to the level of poker play of four players P, Q, R and S. I. P always beats Q II. R always beats S III. S loses to P only sometimes IV. R always loses to Q Which of the following can be logically inferred from the above statements? (i) P is likely to beat all the three other players (ii) S is the absolute worst player in the set

(a) (i) only
(b) (ii) only
(c) (i) and (ii)
(d) neither (i) nor (ii)

Ans. **(a)**

Following Hierarchy can be drawn.

$$\left.\begin{array}{l}\text{P}\\\text{Q}\\\text{R}\\\text{S}\end{array}\right\}\text{ Individual comparisons are given so, P is more likely to beat other three}$$

as he beats Q and Q beats R and R beats S, so (i) follows.

But no absolute comparison of P and S given in any given. So (ii) cannot be confirmed.

End of Solution

Q.9 If $f(x) = 2x^7 + 3x - 5$, which of the following is a factor f(x) ?

(a) $(x^3 + 8)$
(b) $(x - 1)$
(c) $(2x - 5)$
(d) $(x + 1)$

Ans. **(b)**

$$\text{f}(x) = 2x^7 + 3x - 5$$

Use option (b), if $(x - 1)$ will be a factor then on putting $x - 1 = 0$

i.e. $(x = 1)$ in f(x).

$$\text{f}(1) = 2(1)^7 + 3 - 5 = 5 - 5 = 0$$

End of Solution

Q.10 In a process, the number of cycles to failure decreases exponentially with an increase in load. At a load of 80 units, it takes 100 cycles for failure. When the load is halved, it takes 10000 cycles for failure. The load for which the failure will happen in 5000 cycles is ________.

(a) 40.00
(b) 46.02
(c) 60.01
(d) 92.02

Ans. **(b)**

End of Solution

Section - II (Computer Science & IT)

One Mark Questions

Q.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 _____.

Ans. **(11)**

We wish to make

$$\neg((p \Rightarrow q) \wedge (\neg r \vee \neg s)) = 1$$

$$\Rightarrow \quad (p \Rightarrow q) \wedge (\neg r \vee \neg s) = 0$$

$$\Rightarrow \quad (p \Rightarrow q) = 0 \quad \ldots(1)$$

or $$\neg r \vee \neg s = 0 \quad \ldots(2)$$

Now (1) is satisfies only when $p = 1$ and $q = 0$

Equation (2) $\neg r \vee \neg s$ = iff $r \wedge s = 1$

i.e. $r = 1$ and $s = 1$

i.e. x is a perfect square and x is a prime number. Which is not possible so condition (2) cannot be satisfied by any x.

So condition (1) must be satisfies which is $p = 1$ and $q = 0$

i.e. $x \in \{8, 9, 10, 11, 12,\}$ and x is not a composite.

Now the only value of x which satisfies this is $x = 11$

So correct answer is $x = 11$.

End of Solution

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

(a) $a_n = a_{n-1} + 2a_{n-2}$

(b) $a_n = a_{n-1} + a_{n-2}$

(c) $a_n = 2a_{n-1} + a_{n-2}$

(d) $a_n = 2a_{n-1} + 2a_{n-2}$

Ans. **(b)**

Let a_n be the number of n-bit strings that do not contain two consecutive 1's. we wish to develop a recurrence relation for a_n.

Consider 1 bit strings 0, 1

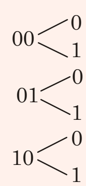
So $a_1 = 2$

Consider 2 bit strings 00, 01, 10, 11

Out of minimum only 00, 01, 10 do not contain two consecutive 1's

So $a_2 = 3$

Consider 3 bit strings



Out of minimum six strings only 000, 001, 010, 100 and 101 five strings satisfy do not contain two consecutive 1's.

So $a_3 = 5$. Three numbers a_1, a_2, a_3 satisfy clearly only (b) $a_n = a_{n-1} + a_{n-2}$ is correct.

End of Solution

Q.3 $\lim_{x \to 4} \dfrac{\sin(x-4)}{x-4} =$ _____ .

Ans. **(1)**

$$\lim_{x \to 4} \frac{\sin(x-4)}{x-4}$$

Let $x - 4 = t$ not as $x \to 4$ $t \to 0$

So the requires limit is $\lim_{t \to 0} \dfrac{\sin(t)}{t} = 1$

End of Solution

Q.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 _____.

Ans. **(0.5)**

Given,

$$f(x) = \frac{1}{x^2} \quad a \le x \le 1$$
$$= 0 \quad \text{elsewhere}$$

So
$$\int_a^1 f(x) = 1$$

$\Rightarrow$
$$\int_a^1 \frac{1}{x^2} = 1$$

$\Rightarrow$
$$\left[\frac{-1}{x}\right]_a^1 = 1$$

$$-\left[\frac{1}{1} - \frac{1}{a}\right] = 1$$

$\Rightarrow$
$$\frac{1}{a} = 2$$

$\Rightarrow$
$$a = \frac{1}{2} = 0.5$$

End of Solution

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

Ans. **(15)**

Two eigen values are $2 + i$ and 3 of a 3×3 matrix. The third eigen value must be $2 - i$

Now
$$\Pi\lambda_i = |A|$$

$\Rightarrow$
$$|A| = (2 + i)\,(2 - i) \times 3 = (4 - i^2) \times 3$$
$$= 5 \times 3 = 15$$

End of Solution

Q.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

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

Ans. (a)

$$x \# 0 = x \quad \ldots 1$$
$$x \# 1 = \bar{x} \quad \ldots 2$$
$$x \# x = 0 \quad \ldots 3$$
$$x \# \bar{x} = 1 \quad \ldots 4$$
$$x \# y = x\bar{y} + \bar{x}y$$

x	y	$x \# y$
0	0	0
0	1	1
1	0	1
1	1	0

End of Solution

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

Ans. (–11)

$\boxed{1}$111 1111 1111 0101 ← Given number in 2's complement form
No. is –ve

0000 0000 0000 1011 ← 2's of the number.
∴ Decimal equivalent is –11.

End of Solution

Q.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 ______.

Ans. (4)
Design synchronous counter using 4 flip-flops for the sequence

$$\rightarrow 0 \rightarrow 1 \rightarrow 4 \rightarrow 2 \rightarrow 8 \rightarrow 3 \rightarrow$$

use J-K FF's.
Read the output from FF1 and FFO only. So, that counter switching sequence is

$$\rightarrow 0 \rightarrow 1 \rightarrow 0 \rightarrow 2 \rightarrow 0 \rightarrow 3 \rightarrow$$

Note: Don't read output from FF3 and FF2.

End of Solution

Q.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.

Ans. **(31)**

Main memory size = 4 GB
Word size = 2 byte
1 word — 2 byte
? words — 4 GB
$\therefore$ Total 2 G words are present.
So, address size = 31 bits.

End of Solution

Q.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)?

(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 $\Omega(\log n)$

Ans. **(a)**

Implementing queue using array:

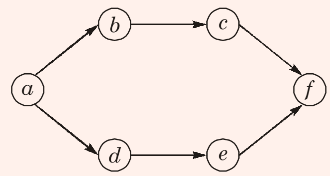
ENQUEUE Operation:
Check array full or not
if array is full
    stop
else enter the element in the end of array;
which will take O(1) time.

DEQUEUE Operation:
Check array empty or not
if array is empty
    stop
else delete the element from front of array and increment the head value (pointer to the starting element of array).
which will take O(1) time.

So for array implementation of queue, ENQUEUE and DEQUEUE operation takes O(1) time.

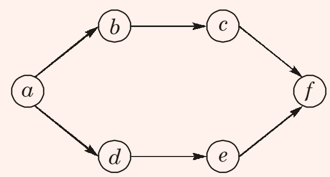
End of Solution

Q.11 Consider the following directed graph:



The number of different topological ordering of the vertices of the graph is______.

Ans. **(6)**



Number of topological orders: 6

a b c d e f
a b d e c f
a d b c e f
a d b c e f
a d e b c f
a d b e c f

End of Solution

Q.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?

(a) $f(s,\ {*s})$
(b) $i = f(i,\ \text{s})$
(c) $f(i,\ {*s})$
(d) $f(i,\ {*p})$

Ans. **(d)**

$f(s,\ {*s})$ since there is no pointer variable define with $*s$. So this function will give type checking error.

$i = f(i, \text{s})$ since function prototype is void in void f (int, short) i.e., f is accepting argument int type and short type and its return type should be integer because we store the output of function in variable i which is integer type. So there must be type casting into integer type but type casting is not present.

So this function will give type checking error.
$f(i, *s)$ since there is no pointer variable define with $*s$. So this function will give type checking error.
$f(i, *p)$ in this function to argument are pass one is int type and another is short type defined in the main function. So this function will not give type checking error.

End of Solution

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

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

Ans. **(d)**

The worst case time complexity of algo given are:
Insertion sort = $\Theta(n^2)$
Merge sort = $\Theta(n \log n)$
Quick sort = $\Theta(n^2)$

End of Solution

Q.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?

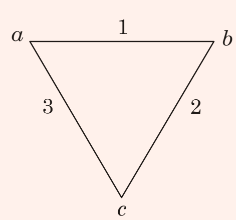
P: Minimum spanning tree of G does not change
Q: Shortest path between any pair of vertices does not change

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

Ans. **(a)**

Statement P: Since every edge weight is positive and we increase the value of every edge weight by same constant values. So minimum spanning tree of G does not change.

Statement Q: Taking an example:



First path from 'a' to 'c' via 'b' have path value 3. But here path can be change 'a' to 'e' direct since paths value is same but path can be change. So statement is wrong.

End of Solution

Q.15 Consider the following C program.

```
#include<stdio.h>
void mystery (int *ptra, int *ptrb)
{   int *temp;
    temp = ptrb;
    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 _____.

Ans. **(2016)**

a	b	c	d
2016	0	4	42
100	200	300	400

1. Mystery (&a, &b); address of 'a' and 'b' is passed.

*ptr a = &a; *ptr b = &b;

ptr a	ptr b	temp
100	~~200~~ 100	200
1000	2000	3000

$$\left.\begin{array}{l}1.\ \text{temp} = \text{ptr } b; \Rightarrow \text{temp} = 200\\ 2.\ \text{ptr } b = \text{ptr } a; \Rightarrow \text{ptr } b = 100\\ 3.\ \text{ptr } a = \text{temp}; \Rightarrow \text{ptr } a = 200\end{array}\right\}\text{No effect on variable 'a' and 'b'}$$

2. if (2016 < 4) false
So, mystery (&a, &b);

*ptr a = &a; *ptr b = &d;

ptr a	ptr b	temp
100	~~200~~ 100	400
1000	2000	3000

$$\left.\begin{array}{l}1.\ \text{temp} = \text{ptr } b; \Rightarrow \text{temp} = 400\\ 2.\ \text{ptr } b = \text{ptr } a; \Rightarrow \text{ptr } b = 100\\ 3.\ \text{ptr } a = \text{temp}; \Rightarrow \text{ptr } a = 400\end{array}\right\}\text{No effect on variable 'a' and 'd'}$$

Print$f$("a"); $\Rightarrow$ 2016

So, output of above program is 2016.

End of Solution

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

$$S \rightarrow aS|bS|\varepsilon$$

(a) $\{a^n b^m | n, m \geq 0\}$

(b) $\{w \in \{a, b\}^* | w$ has equal number of a's and b's $\}$

(c) $\{a^n | n \geq 0\} \cup \{b^n | n \geq 0\} \cup \{a^n b^n \ | n \geq 0\}$

(d) $\{a, b\}^*$

Ans. **(d)**

$G : S \rightarrow aS | bS | \varepsilon$

$L(G) = \{a, b\}^*$.

End of Solution

Q.17 Which of the following decision problems are undecidable?

I. Given NFAs N_1 and N_2, is $L(N_1) \cap L(N_2) = \Phi$?

II. Given a CFG $G = (N, \Sigma, P, S)$ and a string $x \in \Sigma^*$, does $x \in L(G)$?

III. Given CFGs G_1 and G_2, is $L(G_1) = L(G_2)$?

IV. Given a TM M, is $L(M) = \Phi$?

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

Ans. **(c)**

I. Disjointedness problem of regular – Decidable

II. Membership of CFL's – Decidable

III. Equivalence of CFL's – Undecidable

IV. Emptiness of RE language's – Undecidable

III and IV only is correct answer.

End of Solution

Q.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*?

(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

Ans. **(b)**

We wish to find regular expression "for all binary strings containing two consecutive 0's and two consecutive is"
Now, choice (a) cannot generate "00011"
Choice (b) is correct
Choice (c) "00" which does not belong to given language.
Choice (d) always ends with 11 or 00 and hence cannot generate "001101".

End of Solution

Q.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 _____.

Ans. **(7)**

End of Solution

Q.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?

(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

Ans. **(a)**

To minimize the average waiting time, we need to select the shortest remaining time process first, because all are arriving at the same time, and they have unequal CPU burst times.

All other options will not minimize the waiting time. So, the answer is SRTF algorithm.

End of Solution

Q.21 Which of the following is NOT a superkey in a relational schema with attributes V, W, X, Y, Z and primary key $V\ Y$?

(a) $V\ X\ Y\ Z$
(b) $V\ W\ X\ Z$
(c) $V\ W\ X\ Y$
(d) $V\ W\ X\ Y\ Z$

Ans. **(b)**

In $V\ W\ X\ Z$ no complete candidate key exists.

So, it is not super key

End of Solution

Q.22 Which one of the following is NOT a part of the ACID properties of database transactions?

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

Ans. **(d)**

ACID stands for

A: Atomicity

C: Consistency

I: Isolation

D: Durability

So, deadlock-freedom is not the ACID property.

End of Solution

Q.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?

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

Ans. **(b)**

Journal (Volume, Number, Startpage, Endpage, Title, Year, Price)

Primary key: Volume, Number, Startpage, Endpage

FD's: Volume Number Startpage Endpage $\to$ Title

Volume number $\to$ Year

Volume Number, Startpage Endpage $\to$ Price

Given relation 1NF but not 2NF. This DB is redesigned following schemas

R_1(Volume, Number Startpage Endpage Title Price) which has FD's

Volume Number, Startpage Endpage $\to$ Title

Volume Number Startpage Endpage $\to$ Price

Which is in BCNF.

R_2(Volume, Number, Year)

Volume Number $\to$ Year

Which is also in BCNF.

Journal in 1NF

R_1 R_2 in BCNF

Weakest NF which satisfy R_1 and R_2 and fails for journal is 2NF.

End of Solution

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

(a) DNS (b) ARP

(c) DHCP (d) RARP

Ans. **(a)**

DNS is used for mapping host name to IP address.

End of Solution

Q.25 Which of the following is/are example(s) of statefull application layer protocols?

(*i*) HTTP (*ii*) FTP

(*iii*) TCP (*iv*) POP3

(a) (*i*) and (*ii*) only (b) (*ii*) and (*iii*) only

(c) (*ii*) and (*iv*) only (d) (*iv*) only

Ans. **(c)**

FTP has control and data connection it requires authorization. HTTP is stateless protocol. TCP is not application layer but it is statefull. POP3 is application protocol and it gets state with help of TCP.

End of Solution

Q.26 The coefficient of x^{12} in $(x^3 + x^4 + x^5 + x^6 + ...)^3$ is ________.

Ans. **(10)**

We wish to find coefficient of x^{12} in $(x^3 + x^4 + x^5 + ...)^3$

$$= (x^3(1 + x^1 + x^2 + ...))^3$$

$$= x^9(1+x+x^2......)^3$$

$$= \frac{x^9}{(1-x)^3} = x^9\sum_{r=0}^{\infty} 3-1+{}^rC_rX^r$$

$$= x^9\sum_{r=0}^{\infty} r+{}^2C_rX^r$$

Now to make x^{12} we need to put $r = 3$

So coefficient of x^{12} is ${}^{3+2}C_3 = {}^5C_3 = {}^5C_2 = 10$

End of Solution

Q.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 ________.

Ans. **(198)**

Given $\quad a_n = 6n^2 + 2n + a_{n-1}$ and $a_1 = 8$

We wish to find a_{99}

Now $\quad a_2 = 6 \times 2^2 + 2 \times 2 + a_1$

$a_3 = 6 \times 3^2 + 2 \times 3 + a_2$

$= 6 \times 3^2 + 2 \times 3 + 6 \times 2^2 + 2 \times 2 + a_1$

$a_{99} = 6 \times 99^2 + 2 \times 99 + 6 \times 98^2 + 2 \times 98....$

$......+ 6 \times 2^2 + 2 \times 2 + a_1$

Since $\quad a_1 = 8$

$a_{99} = 6 \times 99^2 + 2 \times 99 + 6 \times 98^2 + 2 \times 98...$

$...+ 6 \times 2^2 + 2 \times 2 + 8$

$= 6 \times 99^2 + 2 \times 99 + 6 \times 98^2 + 2 \times 98...$

$...6 \times 2^2 + 2 \times 2 + 6 \times 1^2 + 2 \times 1$

$= 6(1^2 + 2^2 + 3^2...99^2) + 2.(1 + 2 + 3...99)$

$$= 6\cdot\frac{(99(99+1)(2\times 99+1))}{6} + 2\left(\frac{99(99+1)}{2}\right)$$

$= 99 \times 100 \times 199 + 99 \times 100$

$= 100 \times 99\ (199 + 1)$

$= 100 \times 99 \times 200$

$= 2 \times 99 \times 10^4$

$= 198 \times 10^4$

so $\quad$ if $a_{99} = K \times 10^4$

then $\quad K = 198$

End of Solution

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

$f(n) = f(n/2)$ if n is even
$f(n) = f(n+5)$ if n 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 _______.

Ans. **(3)**

$$f(n) = f\left(\frac{n}{2}\right) \text{ if } n \text{ is even}$$

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

$f : N^+ \rightarrow N^+$

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

$$f(3) = f(3+j) = f(8) = f\left(\frac{8}{2}\right) = f(4)$$

$$= f\left(\frac{4}{2}\right) = f(2) = (1)$$

So $$f(1) = f(2) = f(3) = f(4) = f(8)$$

Now let us find $f(5) = f(5+5) = f(10) = f\left(\frac{10}{2}\right) = f(5)$ so $f(5) = f(10)$

Now let us find $f(9)$

$$f(9) = f(9+5) = f(14) = f\left(\frac{14}{2}\right) = f(7)$$

$$= f(7+5) = f(12) = f\left(\frac{12}{2}\right) = f(6)$$

So $$f(9) = f(7) = f(6)$$

For $n > 10$, it will be equal to one of $f(1), f(2)....f(10)$

So the maximum no. of distinct values f takes is only 3.

First is $f(1) = f(2) = f(3) = f(4) = f(8)$

Second is $f(5) = f(10)$

Third is $f(6) = f(7) = f(9)$

All other n values will give only one of these three values.

End of Solution

Q.29 Consider the following experiment.

Step 1. Flip a fair coin twice.

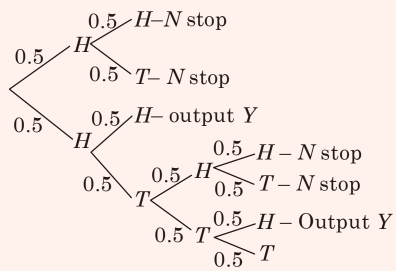
Step 2. If the outcomes are (TAILS, HEADS) then output Y and stop.

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).

Ans. **(0.33)**



The tree diagram for the processes is given above

The desired output is Y.

Now by rule of total probability

$$p(\text{output} = y) = 0.5 \times 0.5 + 0.5 \times 0.5 \times 0.5 \times 0.5 + ...$$

Infinite geometric series with

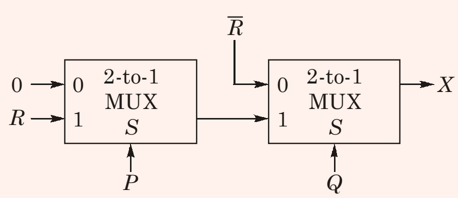
$$a = 0.5 \times 0.5$$

and $$r = 0.5 \times 0.5$$

so $$p(\text{output} = y) = \frac{0.5 \times 0.5}{1 - 0.5 \times 0.5} = \frac{0.25}{0.75} = \frac{1}{3} = 0.33$$ (upto 2 diagonal places)

End of Solution

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



The minimal sum of products form of the output X is

(a) $\bar{P}\bar{Q} + PQR$

(b) $\bar{P}Q + QR$

(c) $PQ + \bar{P}\bar{Q}\bar{R}$

(d) $\bar{Q}\bar{R} + PQR$

Ans. **(d)**

MUX-1 output $\Rightarrow$ $\bar{P}(0) + P(R) = PR$

MUX-2 output $\Rightarrow$ $X = \bar{Q}(\bar{R}) + Q(PR) = \bar{Q}\bar{R} + PQR$

End of Solution

Q.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 ________.

Ans. **(456)**

Data count register = 16 bits.

So, count value = 2^{16} = 64 K bytes

One time control, transfer — 64 K bytes

Number of controls to transfer — 29154 K bytes

456 times system BUS control is required.

End of Solution

Q.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.

Ans. **(33.28)**

P_1: 4-stage

$$t_p = \text{Max (stage delay)} = 800 \text{ ps}$$

1 instruction — 800 ps

? number of instruction — 1 sec

$$TP_R = 1250 \text{ instruction/sec}$$

P_2: 5-stage $\quad t_p = 600 \text{ ps}$

1 instruction — 600 ps

? number of instruction — 1 sec

$$TP_{P2} = 1666 \text{ instruction/sec}$$

1250 — 100% (old)

(1666 – 1250) — ? (New)

$$\Rightarrow \quad \frac{416}{1250} = 0.3328$$

i.e., 33.28%

End of Solution

Q.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

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

Ans. **(b)**

The gates to be used in CLA adder with the fan-in at the most '2'.

$\therefore$ Time to perform addition using this adder is $\Theta(\log(n))$.

End of Solution

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

```
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

(a) $a\ != n$
(b) $b\ != 0$
(c) $b > (a + 1)$
(d) $b\ != a$

Ans. **(d)**

Option (a) is fail for descending array. Since n value is not decreament in program.

Option (b) is fail for ascending array. Since value of 'a' is increment every time and in while condition we check for value of 'b'. So it is incorrect.

Option (c) is fail for input 5 6 7 1 2 3. Since which pointer a is pointing to 6 and 'b' will pointing to 7 i.e., 'a' and 'b' are adjacent to each other. Then while condition $b > (a + 1)$ is fail and it return 6 is maximum value which is incorrect.

Option (d) at the end of the program pointer 'a' and 'b' pointed to same element then only while condition is false and return the maximum value of array.

End of Solution

Q.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);
}
```

(a) 3 1 2 2 1 3 4 4 4 (b) 3 1 2 1 1 1 2 2 2

(c) 3 1 2 2 1 3 4 (d) 3 1 2 1 1 1 2

Ans. **(a)**

D $\boxed{\cancel{1}\ \cancel{2}}$ $\cancel{3}$ 4

count (3)
n $\boxed{3}$
1. Print$f(n)$ = 3
2. Print$f(d)$ = 1
   d++;
   if (3 > 1) true
   count (2)
9. Print$f(d)$ = 4

n $\boxed{2}$
3. Print$f(n)$ = 2
4. Print$f(d)$ = 2
   d++;
   if (2 > 1) true
   count (1)
8. Print$f(d)$ = 4

$\boxed{n}$ 1
5. Print$f(n)$ = 1
6. Print$f(d)$ = 3
   d++;
   if (1 > 1) false
   count (1)
7. Print$f(d)$ = 4

So output will be printed in serial order given in solution i.e., 312213444.

End of Solution

Q.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);
}
```

(a) 6, 2 (b) 6, 6

(c) 4, 2 (d) 4, 4

Ans. **(c)**

$a\ \boxed{\cancel{3}\,\cancel{1}\,2}$ globaly initialize.

1. $m(3)$

$y\ \boxed{3}$

1. $a = 1$ since not declared here. So free variable.
2. $a = 3 - 1 = 2$

$n(a)$;

$n(2)$

$x\ \boxed{2}$

$x = x * a$;
$= 2 * 2$ (here a is taken from global variable)
$= 4$

Print$f(4)$; = 4

3. Print$f(a)$ = 2 global value of 'a'

So answer will be 4, 2.

End of Solution

Q.37 An operator *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?

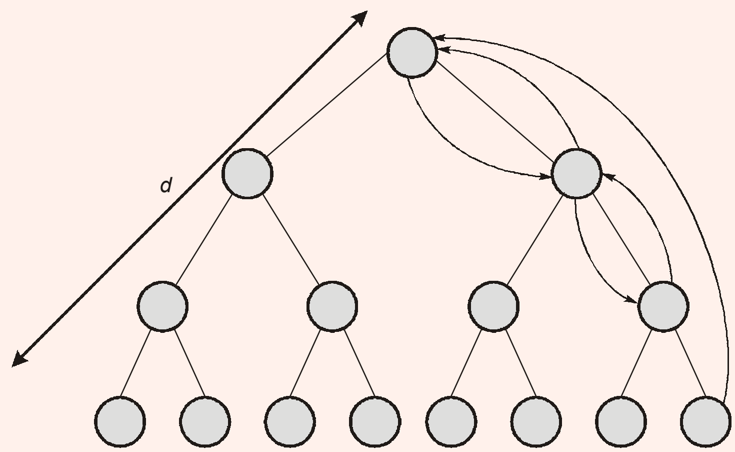
(a) $O(1)$ (b) $O(d)$ but not $O(1)$
(c) $O(2^d)$ but not $O(d)$ (d) $O(d2^d)$ but not $O(2d)$

Ans. (b)

Heap is implemented using array. If 'i' is parent element then '$2i$' is left child and '$2i+1$' is right child.

So if an element is delete from last level of the heap then it will take $O(1)$ time. Since element can be deleted from any level of heap tree in worst case root element is deleted then at every level one element is exchange.

Example:



Minimum $O(d)$ time will take if a element is deleted in heap tree but not $O(1)$.

End of Solution

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

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

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 ________.

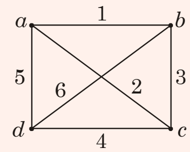
Ans. (11)

End of Solution

Q.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 ________.

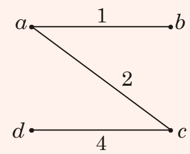
Ans. **(7)**

Since graph will be complete graph contain 4 vertex and 6 edges with weight 1, 2, 3, 4, 5, 6.



If we consider edge weights in such order, that form the cycle, then we have to choose two minimum we choose minimum value i.e., 4.

So MST will be



So max weight will be 1 + 2 + 4 = 7.

End of Solution

Q.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?

I. If e is the lightest edge of *some* cycle in G, then every MST of G *includes* e.

II. If e is the heaviest edge of *some* cycle in G, then every MST of G *excludes* e.

(a) I only
(b) II only
(c) both I and II
(d) neither I nor II

Ans. **(c)**

End of Solution

Q.41 Let Q denote a queue containing sixteen numbers and S be an empty stack. Head(Q) returns the element at the head of the queue Q without removing it from Q. Similarly Top(S) returns the element at the top of S without removing it from S. Consider the algorithm given below.

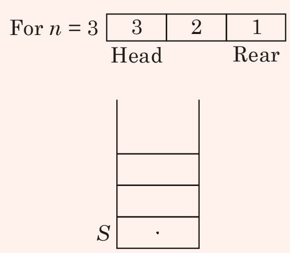
while *Q is not Empty* do
if *S* is *Empty OR Top* (*S*) $\leq$ Head(*Q*) then
    x : = Dequeue (*Q*);
    Push (*S*, *x*);
    else
        x : = Pop (*S*);
        Enqueue (*Q*, *x*);
    end
end

The maximum possible number of iterations of the **while** loop in the algorithm is ________.

Ans. **(256)**

The minimum number of iterations of the while loop in algorithm when use take queue contain element in ascending order i.e., 1, 2, 3, 4, . . . , 16 is 16. The maximum number of iterations of while loop in algorithm when we take queue containing elements in descending order i.e., 16, 15, 14, . . . , 1. First 16 will push into stack and then enqueue it in the end of the queue. This process do till we get 1 as head element. When head point to 1 then simple push the 1 in stack. In this manner we have to push all element in stack in assending order, until queue is empty it will take 256 of iterations.

Example:



Sequence of operation with while loop execution.

1. dequeue (3)
   push (3)
2. pop (3)
   enqueue (3)
3. dequeue (2)
   push (2)
4. pop (2)
   enqueue (2)
5. dequeue (1)
   push (1)
6. dequeue (3)
   push (3)
7. pop (3)
   enqueue (3)
8. dequeue (2)
   push (2)
9. dequeue (3)
   push (3)

So for n = 3 it takes 3 × 3 = 9 iterations of while loop in algorithm. So, for n = 16 it will take 16 × 16 = 256 iterations of while loop.

End of Solution

Q.42 Consider the following context-free grammars:

G$_1$: $S \to aS|B,\ B \to b|bB$

G$_2$: $S \to aA|bB,\ A \to aA|B|\varepsilon,\ B \to bB|\varepsilon$

Which one of the following pairs of languages is generated by G_1 and G_2, respectively?

(a) $\{a^m b^n | m > 0 \text{ or } n > 0\}$ and $\{a^m b^n | m > 0 \text{ and } n > 0\}$

(b) $\{a^m b^n | m > 0 \text{ and } n > 0\}$ and $\{a^m b^n | m > 0 \text{ or } n \geq 0\}$

(c) $\{a^m b^n | m \geq 0 \text{ or } n > 0\}$ and $\{a^m b^n | m > 0 \text{ and } n > 0\}$

(d) $\{a^m b^n | m \geq 0 \text{ and n} > 0\}$ and $\{a^m b^n | m > 0 \text{ or } n > 0\}$

Ans. **(d)**

G_1: $S \to aS|B$

$B \to b|bB$

G_2: $S \to aA|bB$

$A \to aA|B|\varepsilon$

$B \to bB|\varepsilon$

G: $B \to b|bB \Rightarrow B \to b^+$

Now substitute in $S \to aS|B$

We get $S \to aS\,|\,b^+ \Rightarrow S \to a^*\,b^+$

So, $L(G_1) = \{a^m b^n | m \geq 0 \text{ and } n > 0\}$

$(G_2) = B \to bB|\varepsilon \Rightarrow B \to b^*$

Substitute in $A \to aA|B|\varepsilon \Rightarrow A \to aA\,|\,b^*\,|\,\varepsilon \Rightarrow A \to aA|b^*$

$\Rightarrow A \to a^*b^*$

Now substitue A and B in $S \to aA|bB$

$\Rightarrow S \to aa^*\,b^*|bb^*$

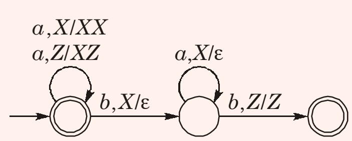
$S \to aa^*\,b^* + bb^*$

So $L(h_2) = \{a^m b^n | m > 0 \text{ or } n > 0\}$

So correct answer is choice (d).

End of Solution

Q.43 Consider the transition diagram of a PDA given below with input alphabet $E = \{a, b\}$ and stack alphabet $r = \{X, Z\}$. Z is the initial stack symbol. Let L denote the language accepted by the PDA.



Which one of the following is TRUE?

(a) $L = \{a^n b^n \mid n \geq 0\}$ and is not accepted by any finite automata

(b) $L = \{a^n \mid n \geq 0\} \cup \{a^n b^n \mid n \geq 0\}$ and is not accepted by any deterministic PDA

(c) L is not accepted by any Turing machine that halts on every input

(d) $L = \{a^n \mid n \geq 0\} \cup \{a^n b^n \mid n \geq 0\}$ and is deterministic context-free

Ans. **(a)**

The first state accepts only null string. Only a's will not be accepted since on first state ε, X will be dead reject.

The third state accept is $\{a^n b^n \mid \text{n} \geq 1\}$

So $$L = \{\varepsilon\} \cup \{a^n b^n \geq 1\}$$
$$= \{a^n b^n \mid \text{n} \geq 0\}$$

Clearly this is a non-regular CFL and hence not accepted by any FA.

End of Solution

Q.44 Let X be a recursive language and Y be a recursively enumerable but not recursive language. Let W and Z be two languages such that Y reduces to W, and Z reduces to X (reduction means the standard many-one reduction). Which one of the following statements is TRUE?

(a) W can be recursively enumerable and Z is recursive.
(b) W can be recursive and Z is recursively enumerable.
(c) W is not recursively enumerable and Z is recursive.
(d) W is not recursively enumerable and Z is not recursive.

Ans. **(c)**

$X \rightarrow$ REC
$Y \rightarrow$ RE but not REC

$\bar{Y} \leq W$ and $Z \leq \bar{X}$

Now we know that RE, REC both go in reverse direction on reduction.

Now, if Y is RE but not REC, then $\bar{Y}$ is not RE.

Now $\bar{Y} \leq$ W

If W is RE $\Rightarrow$ $\bar{Y}$ is RF

Composition is $\bar{\text{Y}}$ is not RE $\Rightarrow$ W is not RE

Now $Z \leq \bar{X}$

If X is REC, $\bar{X}$ is also REC

So $\bar{X}$ REC $\Rightarrow$ Z is REC
So W is not RE and Z is REC.
Choice (c) is correct.

End of Solution

Q.45 The attributes of three arithmetic operators in some programming language are given below.

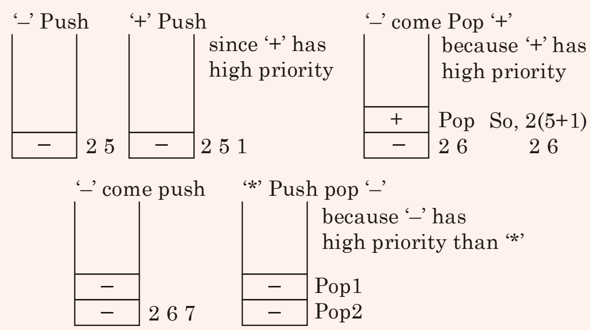
Operator	Precedence	Associativity	Arity
+	High	Left	Binary
–	Medium	Right	Binary
*	Low	Left	Binary

The value of the expression 2 – 5 + 1 – 7*3 in this language is _______.

Ans. **(9)**

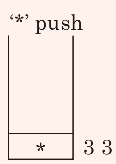
Since given expression in infix expression. So we use operator stack.

2 – 5 + 1 – 7 * 3



So, 2 – (6 – 7) ∴ '–' right associative.

2 – (–1) = 3



String finish so pop '*'

So, 3*3 = 9.

So, 2 – 5 + 1 – 7 * 3 evaluates to 9.

End of Solution

Q.46 Consider the following Syntax Directed Translation Scheme (SDTS), with non-terminals $\{S, A\}$ and terminals $\{a, b\}$.

$S \rightarrow aA$	{print 1}
$S \rightarrow a$	{print 2}
$A \rightarrow Sb$	{print 3}

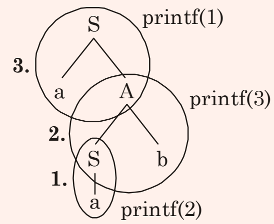
Using the above SDTS, the output printed by a bottom-up parser, for the input *aab* is:

(a) 1 3 2
(b) 2 2 3
(c) 2 3 1
(d) syntax error

Ans. **(c)**

Input is '*aab*'

So tree for given input.



So output will be 2, 3 and 1 because printed order will be 1, 2, 3.

So output: 2 3 1

End of Solution

Q.47 Consider a computer system with 40-bit virtual addressing and page size of sixteen kilobytes. If the computer system has a one-level page table per process and each page table entry requires 48 bits, then the size of the per-process page table is _______ megabytes.

Ans. **(384)**

Page table size = Number of entries in page table × Page table entry size

$$= \left(\frac{2^{40}}{2^{14}}\right) \times 48 \text{ bits} = 2^{26} \times 6 \text{ bytes}$$

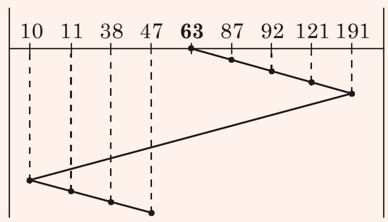
$$= 64 \text{ M} \times 6 \text{ B} = 384 \text{ MB}$$

End of Solution

Q.48 Consider a disk queue with requests for I/O to blocks on cylinders 47, 38, 121, 191, 87, 11, 92, 10. The C-LOOK scheduling algorithm is used. The head is initially at cylinder number 63, moving towards larger cylinder numbers on its servicing pass. The cylinders are numbered from 0 to 199. The total head movement (in number of cylinders) incurred while servicing these requests is_______.

Ans. **(346)**

C-Look



(84 – 63) + (92 – 87) + (121 – 92) + (191 – 121) + (191 – 10) + (11 – 10) + (38 – 11) + (47 – 38)

= 24 + 5 + 29 + 70 + 181 + 1 + 27 + 9 = 346

End of Solution

Q.49 Consider a computer system with ten physical page frames. The system is provided with an access sequence ($a_1, a_2, ..., a_{20}, a_1, a_2, . . ., a_{20}$), where each a_i is a distinct virtual page number. The difference in the number of page faults between the last-in-first-out page replacement policy and the optimal page replacement policy is________.

Ans. **(1)**

This question is little tricks, but not difficult. You can solve the problem by taking smaller example with smaller values.

Example: 1, 2, 3, 4, 1, 2, 3, 4 with '2' frames.

LIFO: 1, 2, 3, 4, 1, 2, 3, 4

	$\cancel{2}$	$\cancel{3}$	$\cancel{4}$	$\cancel{4}$	$\cancel{2}$	3	4
1	1	1	1	1	1	1	1
F	F	F	F		F	F	F

Total page faults = 7

Optimal: 1, 2, 3, 4, 1, 2, 3, 4

	$\cancel{2}$	$\cancel{3}$	4	4	4	4	4
1	1	1	1	$\cancel{1}$	$\cancel{2}$	3	3
F	F	F	F		F	F	

Total page faults = 6

7 – 6 = 1.

End of Solution

Q.50 Consider the following proposed solution for the critical section problem. There are n processes: $P_0 . . . P_{n-1}$. In the code, function *pmax* returns an integer not smaller than any of its arguments. For all i, $t[i]$ is initialized to zero.

Code for P_i:

```
do
{
    c[i]=1; t[i] = pmax (t[0],..., t[n–1]) +1;
    for every j ≠ i in {0,..., n–1}
    {   while (c[ j]);
        while (t[ j] != 0 && t[ j] <= t[i]);
    }
    Critical Section; t[i] = 0;
Remainder Section;
}   while (true);
```

Which one of the following is TRUE about the above solution?

(a) At most one process can be in the critical section at any time
(b) The bounded wait condition is satisfied
(c) The progress condition is satisfied
(d) It cannot cause a deadlock

Ans. **(a)**

It satisfies the mutual exclusion, so only one process can be in the critical section at any time.

End of Solution

Q.51 Consider the following two phase locking protocol. Suppose a transaction T accesses (for read or write operations), a certain set of objects $\{O_1, \ldots, O_k\}$. This is done in the following manner:

Step 1. T acquires exclusive locks to $O_1, \ldots, O_k$ in increasing order of their addresses.
Step 2. The required operations are performed.
Step 3. All locks are released.

This protocol will

(a) guarantee serializability and deadlock-freedom
(b) guarantee neither serializability nor deadlock-freedom
(c) guarantee serializability but not deadlock-freedom
(d) guarantee deadlock-freedom but not serializability

Ans. **(a)**

2PL over objects $O_1 \ldots O_k$

Step-1: T acquires exclusive lock to $O_1 \ldots O_k$ in increasing order of their address.

Step-2: The required operations are performed.

Step-3: All locks are released.

Because of 2PL it guarantee serializability and objects locks in increasing order of address and all objects locks before read/write which avoids deadlock.

End of Solution

Q.52 Consider that B wants to send a message m that is digitally signed to A. Let the pair of private and public keys for A and B be denoted by K_x^- and K_x^+ for $x = A, B$, respectively. Let $K_x(m)$ represent the operation of encrypting m with a key K_x and $H(m)$ represent the message digest. Which one of the following indicates the CORRECT way of sending the message m along with the digital signature to A?

(a) $\{m, K_B^+(H(m))\}$
(b) $\{m, K_B^-(H(m))\}$
(c) $\{m, K_A^-(H(m))\}$
(d) $\{m, K_A^+(m)\}$

Ans. **(b)**

In digital signature Message is digested represented by $H(m)$ and encrypted with sender's private key i.e., $K_B^-(H(m))$ to create sign and send it along with the original message m.

So, the correct answer is $\{m, K_B^-(H(m))\}$.

End of Solution

Q.53 An IP datagram of size 1000 bytes arrives at a router. The router has to forward this packet on a link whose MTU (maximum transmission unit) is 100 bytes. Assume that the size of the IP header is 20 bytes. The number of fragments that the IP datagram will be divided into for transmission is _______.

Ans. **(13)**

MTU is 100 bytes, IP header is 20 bytes, IP datagram is 1000 bytes.

So, number of fragments are 13.

End of Solution

Q.54 For a host machine that uses the token bucket algorithm for congestion control, the token bucket has a capacity of 1 megabyte and the maximum output rate is 20 megabytes per second. Tokens arrive at a rate to sustain output at a rate of 10 megabytes per second. The token bucket is currently full and the machine needs to send 12 megabytes of data.

The minimum time required to transmit the data is _______ seconds.

Ans. **(1.1)**

Time taken to transmit 1 MB when output rate is 20 MBps, capacity is 1 MB and token arrival rate is 10 MBps is

$$C + \rho S = \text{MS}$$

$$1\text{ MB} + (10\text{ MBps})\times S \Leftarrow (20\text{ MBps})\times S$$

$$S = \frac{1\text{ MB}}{(20-10)\text{MBps}}$$

$$S = \frac{1\text{ MB}}{10\text{ MBps}} = 0.1\,\text{sec}$$

In 0.1 sec data transmit = 0.1 × Output rate

$$= 0.1 \times 20\text{ MBps} = 2\text{ MB}$$

$$\text{Remaining data} = (12\text{ MB} - 2\text{ MB}) = 10\text{ MB}$$

So to transmit 1 MB takes 0.1 sec

$$\text{then for 10 MB} = 10 \times 0.1\text{ sec} = 1\text{ sec}$$

$$\text{Total time} = (0.1 + 1)\text{ sec} = 1.1\text{ sec}$$

End of Solution

Q.55 A sender uses the Stop-and-Wait ARQ protocol for reliable transmission of frames. Frames are of size 1000 bytes and the transmission rate at the sender is 80 Kbps (1 Kbps = 1000 bits/second). Size of an acknowledgment is 100 bytes and the transmission rate at the receiver is 8 Kbps. The one-way propagation delay is 100 milliseconds.

Assuming no frame is lost, the sender throughput is ______ bytes/second.

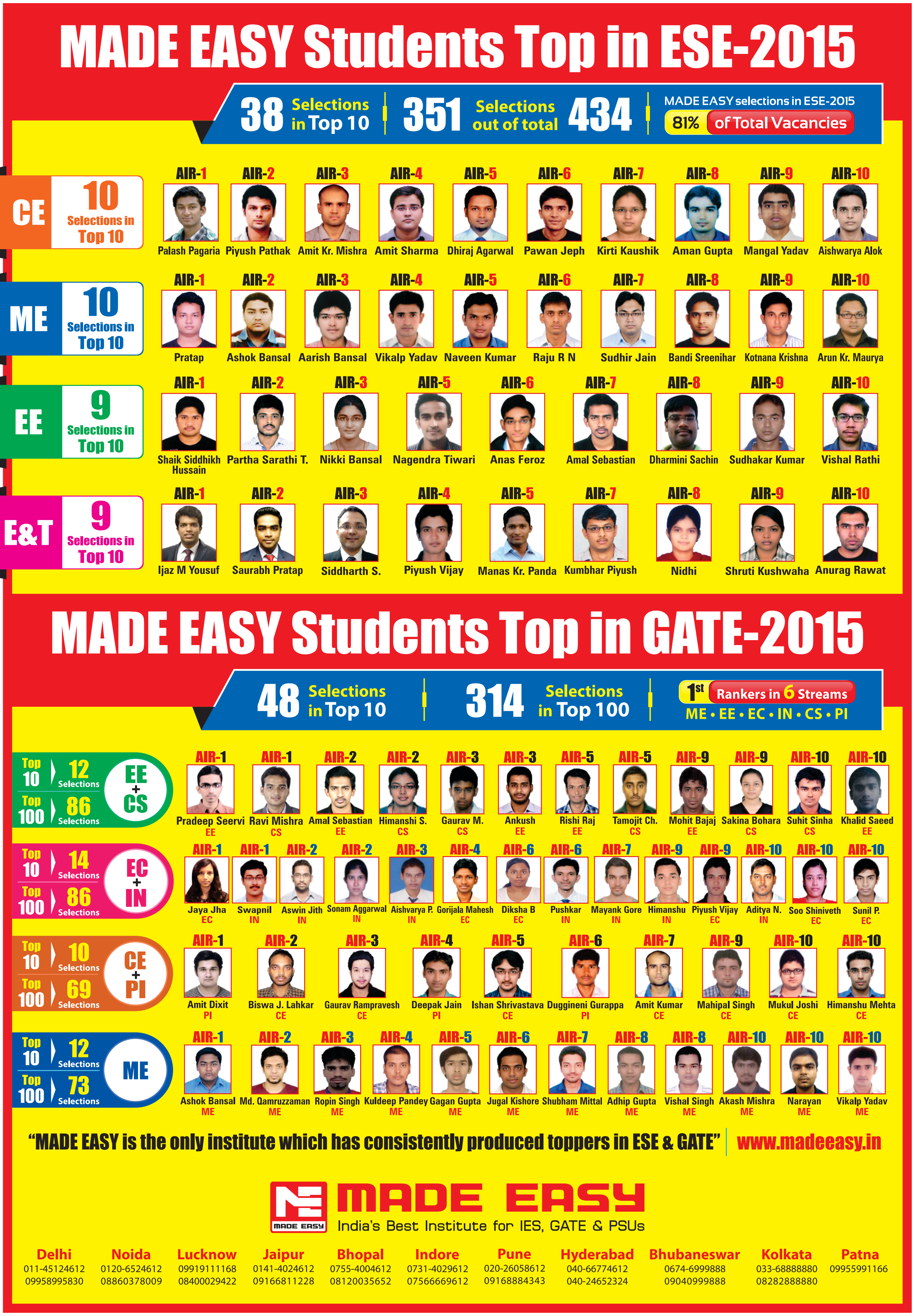
Ans. **(2500)**

$$\text{Sender throughput} = \frac{\text{Data}}{\text{Total time}}$$

$$= \frac{1000 \text{ bytes}}{0.1 + 0.1 + 0.1 + 0.1} = 2500 \text{ bytes/sec}$$

End of Solution

Advt.



MADE EASY Students Top in ESE-2015
38 Selections in Top 10
351 Selections out of total 434
MADE EASY selections in ESE-2015
81% of Total Vacancies
CE 10 Selections in Top 10
AIR-1 Palash Pagaria
AIR-2 Piyush Pathak
AIR-3 Amit Kr. Mishra
AIR-4 Amit Sharma
AIR-5 Dhiraj Agarwal
AIR-6 Pawan Jeph
AIR-7 Kirti Kaushik
AIR-8 Aman Gupta
AIR-9 Mangal Yadav
AIR-10 Aishwarya Alok
ME 10 Selections in Top 10
AIR-1 Pratap
AIR-2 Ashok Bansal
AIR-3 Aarish Bansal
AIR-4 Vikalp Yadav
AIR-5 Naveen Kumar
AIR-6 Raju R N
AIR-7 Sudhir Jain
AIR-8 Bandi Sreenihar
AIR-9 Kotnana Krishna
AIR-10 Arun Kr. Maurya
EE 9 Selections in Top 10
AIR-1 Shaik Siddhikh Hussain
AIR-2 Partha Sarathi T.
AIR-3 Nikki Bansal
AIR-5 Nagendra Tiwari
AIR-6 Anas Feroz
AIR-7 Amal Sebastian
AIR-8 Dharmini Sachin
AIR-9 Sudhakar Kumar
AIR-10 Vishal Rathi
E&T 9 Selections in Top 10
AIR-1 Ijaz M Yousuf
AIR-2 Saurabh Pratap
AIR-3 Siddharth S.
AIR-4 Piyush Vijay
AIR-5 Manas Kr. Panda
AIR-7 Kumbhar Piyush
AIR-8 Nidhi
AIR-9 Shruti Kushwaha
AIR-10 Anurag Rawat
MADE EASY Students Top in GATE-2015
48 Selections in Top 10
314 Selections in Top 100
1st Rankers in 6 Streams
ME • EE • EC • IN • CS • PI
EE + CS: Top 10 12 Selections; Top 100 86 Selections
AIR-1 Pradeep Seervi EE
AIR-1 Ravi Mishra CS
AIR-2 Amal Sebastian EE
AIR-2 Himanshi S. CS
AIR-3 Gaurav M. CS
AIR-3 Ankush EE
AIR-5 Rishi Raj EE
AIR-5 Tamojit Ch. CS
AIR-9 Mohit Bajaj EE
AIR-9 Sakina Bohara CS
AIR-10 Suhit Sinha CS
AIR-10 Khalid Saeed EE
EC + IN: Top 10 14 Selections; Top 100 86 Selections
AIR-1 Jaya Jha EC
AIR-1 Swapnil IN
AIR-2 Aswin Jith IN
AIR-2 Sonam Aggarwal IN
AIR-3 Aishvarya P. IN
AIR-4 Gorijala Mahesh EC
AIR-6 Diksha B EC
AIR-6 Pushkar IN
AIR-7 Mayank Gore IN
AIR-9 Himanshu IN
AIR-9 Piyush Vijay EC
AIR-10 Aditya N. IN
AIR-10 Soo Shiniveth EC
AIR-10 Sunil P. EC
CE + PI: Top 10 10 Selections; Top 100 69 Selections
AIR-1 Amit Dixit PI
AIR-2 Biswa J. Lahkar CE
AIR-3 Gaurav Rampravesh CE
AIR-4 Deepak Jain PI
AIR-5 Ishan Shrivastava CE
AIR-6 Duggineni Gurappa PI
AIR-7 Amit Kumar CE
AIR-9 Mahipal Singh CE
AIR-10 Mukul Joshi CE
AIR-10 Himanshu Mehta CE
ME: Top 10 12 Selections; Top 100 73 Selections
AIR-1 Ashok Bansal ME
AIR-2 Md. Qamruzzaman ME
AIR-3 Ropin Singh ME
AIR-4 Kuldeep Pandey ME
AIR-5 Gagan Gupta ME
AIR-6 Jugal Kishore ME
AIR-7 Shubham Mittal ME
AIR-8 Adhip Gupta ME
AIR-8 Vishal Singh ME
AIR-10 Akash Mishra ME
AIR-10 Narayan ME
AIR-10 Vikalp Yadav ME
"MADE EASY is the only institute which has consistently produced toppers in ESE & GATE"
www.madeeasy.in
MADE EASY
India's Best Institute for IES, GATE & PSUs
Delhi 011-45124612 09958995830
Noida 0120-6524612 08860378009
Lucknow 09919111168 08400029422
Jaipur 0141-4024612 09166811228
Bhopal 0755-4004612 08120035652
Indore 0731-4029612 07566669612
Pune 020-26058612 09168884343
Hyderabad 040-66774612 040-24652324
Bhubaneswar 0674-6999888 09040999888
Kolkata 033-68888880 08282888880
Patna 09955991166