Question. 1

A undirected graph G has n nodes. Its adjacency matrix is given by by an $n \times n$ square matrix whose

1. diagonal elements are $O's$, and
2. non-diagonal elements are 1's. Which one of the following is TRUE?

(A) Graph G has no minimum spanning tree (MST)

(B) Graph G has a unique MST of cost in-1

(C) Graph G has multiple distinct MST's, each of cost n-1

(D) Graph G has multiple spanning trees of different costs

Question. 2

The time complexity of computing the transitive closure of a binary relation on a set of n elements is known to be

(A) $O(n)$ (B) $O(n \log n)$

(C) $O(n^{3/2})$ (D) $O(n^3)$

Question. 3

A priority-Queue is implemented as a Max-Heap, Initially, it has 5 elements. The level-order traversal of the heap is given below:

10, 8, 5, 3, 2

Two new elements '1' and '7' are inserted in the heap in that order. The level-order traversal of the heap after the insertion of the elements is

(A) 10, 8, 7, 5, 3, 2, 1 (B) 10, 8, 7, 2, 3, 1, 5

(C) 10, 8, 7, 1, 2, 3, 5 (D) 10, 8, 7, 3, 2, 1, 5

Question. 4

How many distinct binary search trees can be created out of 4 distinct keys?

(A) 5 (B) 14

(C) 24 (D) 35

Question. 5

In a complete k-ary, every internal node has exactly k children. The number of leaves in such a tree with n internal nodes is

(A) $n\ k$ (B) $(n-1)\,k+1$

(C) $n(k-1)+1$ (D) $n(k-1)$

Question. 6

Suppose $T(n) = 2T(n/2) + n, T(0) = T(1) = 1$

Which one of the following is FALSE?

(A) $T(n) = O(n^2)$ (B) $T(n) = \theta(n\log n)$

(C) $T(n) = \Omega(n^2)$ (D) $T(n) = O(n\log n)$

Question. 7

Let $G\ (V,E)$ an undirected graph with positive edge weights. Dijkstra's single source-shortes path algorithm can be implemented using the binary heap data structure with time complexity?

(A) $O(|\ V|^{2)}$ (B) $O(|\ E|) +|\ V|\log|\ V|)$

(C) $O(|\ V|\log|\ V|)$ (D) $O((|\ E|+|\ V|)\log|\ V|)$

Question. 8

Suppose there are $\log\ n$ sorted lists of $n/\log\ n$ elements each. The time complexity of producing a sorted list of all these elements is: (Hint: Use a heap data structure)

(A) $O(n\text{loglog}n)$ (B) $\theta(n\log n)$

(C) $\Omega(n\log n)$ (D) $\Omega(n^{3/2})$

Data for Q. 9 & 10 are given below.

Solve the problems and choose the correct answers.
Consider the following C-function:

```
double foo(int n){
     int i;
double sum;
if   (n == 0) return 1.0;
     else {
     sum= 0 0;
     for (i = 0;< n;i +)
     sum += goo (i);
     return sum;
     }}
```

Question. 9

The space complexity of the above function is

(A) $O(1)$ (B) $O(n)$

(C) $O(n!)$ (D) $O(n^n)$

Question. 10

The space complexity of the above function is foo O and store the values of foo $(i), 0 <= i < n$, as and when they are computed. With this modification, the time complexity for function foo$O$ is significantly reduced. The space complexity of the modified function would be:

(A) $O(1)$ (B) $O(n)$

(C) $O(n^2)$ (D) $O(n!)$

Data for Q. 11 & 12 are given below,

Solve the problems and choose the correct answers.

We are given 9 tasks T_1, T_2,..... T_9. The execution of each task requires one unit of time. We can execute one task at a time. T_i has a profit P_i and a deadline d_i profit P_i is earned if the task is completed before the end of the d_1^{th} unit of time.

Task	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8	T_9
Profit	15	20	30	18	18	10	23	16	25
Deadline	7	2	5	3	4	5	2	7	3

Question. 11

Are all tasks completed in the schedule that gives maximum profit?

(A) All tasks are completed

(B) T_1 and T_6 are left out

(C) T_1 and T_8 are left out

(D) T_4 and T_6 are left out

Question. 12

What is the maximum profit earned?

(A) 147

(B) 165

(C) 167

(D) 175

Question. 13

The grammar $A \rightarrow AA \mid (A) \mid \varepsilon$ is not suitable for predictive-parsing

because the grammar is

(A) ambiguous

(B) Left-recursive

(C) right-recurisve

(D) an operator-grammar

Question. 14

Consider the grammar $E \rightarrow E + n \mid E \times n \mid n$

For a sentence $n + n$, the handles in the right-sentential form of the reduction are

(A) $n, E + n$ and $\mathrm{E} + \mathrm{n} \times \mathrm{n}$

(B) $n, E + n$ and $\mathrm{E} + \mathrm{E} \times \mathrm{n}$

(C) $n, n + n$ and $n + \mathrm{n} \times \mathrm{n}$

(D) $n, E + n$ and $\mathrm{E} \times \mathrm{n}$

Question. 15

Consider the grammar

$S \rightarrow (S) \mid a$

Let the number of states in SLR(1), LR(1) and LALR(1) parsers for the grammar $n_1 n_2$ and n_3 respectively. The following relationship holds good

(A) $n_1 < n_2 < n_3$ (B) $n_1 = n_3 < n_2$

(C) $n_1 = n_2 = n_3$ (D) $n_1 \geq n_3 \geq n_2$

Question. 16

Consider line number 3 of the following C-program.

```
int main (){                    | * Line 1 * |
int 1, N;                       | * line  2 * |
fro (i = 0, 1 < N, 1 ++);       | * Line 3 * |
}
```

Identify the compiler's response about this line while creating the object-module

(A) No compilation error

(B) Only a lexical error

(C) Only syntactic errors

(D) Both lexical and syntactic errors

Data for Q. 17 & 18 are given below.

Solve the problems and choose the correct answers.

Consider the following expression grammar. The semantic rules for expression calculation are stared next to each grammar production.

```
E →   number     Eval       = number.val
```

```
| E' + 'B    E(1).val    = E(2).VAL +E(3).val
| E' × 'E    E(1).val    = E(2).VAL +E(3).val
;
```

Question. 17

The above grammar and the semantic rules are fed to a yacc tool (which is an LALR(1) parser generator) for parsing and evaluating arithmetic expressions. Which one of the following is true about the action of yacc for the given grammar?

(A) It detects recursion and eliminates recursion

(B) It detects reduce-reduce conflict, and resolves

(C) It detects shift-reduce conflict, and resolves the conflict in favor of a shift over a reduce action

(D) It detects shift-reduce conflict, and resolves the conflict in favor of a reduce over a shift action

Question. 18

Assume the conflicts part (a) of this question are resolved and an LALR(1) parser is generated for parsing arithmetic expressions as per the given grammar. Consider an expression $3 \times 2 + 1$. What precedence and associativity properties does the generated parser realize?

(A) Equal precedence and left associativity; expression is evaluated to 7

(B) Equal precedence and right associativity, expression is evaluated to 9

(C) Precedence of 'x' is higher than that of '+', and both operators are left associative; expression is evaluated to 7

(D) Precedence of '$\times$' is higher than that of '$\times$', and both operators are left associative; expression is evaluated to 9

Question. 19

Packets of the same session may be routed through different paths in

(A) TCP, but not UDP

(B) TCP and UDP

(C) UDP but not TCP

(D) Neither TCP, nor UDP

Question. 20

The address resolution protoc0l (ARP) is used for

(A) Finding the IP address from the DNS

(B) Finding the IP address of the default gateway

(C) Finding the IP address that corresponds to a MAC address

(D) Finding the MAC address that corresponds to an IP address

Question. 21

The maximum window size for data transmission using the selective reject protocol with n-bit frame sequence numbers is

(A) 2^n

(B) 2^{n-1}

(C) $2^n - 1$

(D) 2^{n-2}

Question. 22

In a network of LANs connected by bridges, packets are set from one LAN to another through intermediate bridges. Since more than one path may exist between two LANs, packets may have to be routed through multiple bridges. Why is the spanning tree algorithm used for bridge-routing ?

(A) For shortest path routing between LANs

(B) For avoiding loops in the routing paths

(C) For fault tolerance

(D) For minimizing collisions

Question. 23

An organization has a class B network and wishes to form subnets for 64 departments. The subnet mask would be

(A) 255.255.0.0

(B) 255.255.64.0

(C) 255.255.128.0

(D) 255.255.255.0

Question. 24

In a packet switching network, packets are routed from source to destination along a single path having two intermediate node. If the message size is 24 bytes and each packet contains a header of 3 bytes, then the optimum packet size is

(A) 4 (B) 6

(C) 7 (D) 9

Question. 25

Suppose the round trip propagation delay for a 10 Mbps Ethernet having 48-bit jamming signal is 46.4 μs. The minimum frame size is :

(A) 94 (B) 416

(C) 464 (D) 512

Question. 26

Which one of the following is true for a CPU having a single interrupt request line and a single interrupt grant line?

(A) Neither vectored interrupt nor multiple interrupting devices are possible

(B) Vectored interrupts are not possible but multiple interrupting devices are possible

(C) vectored interrupts and multiple interrupting devices are both possible

(D) vectored interrupt is possible but multiple interrupting devices are not possible

Question. 27

Normally user programs are prevented from handing I/O directly by I/O instructions in them. For CPUs having explicit I/O instructions, such I/O protection is ensured by having the I/O instructions privileged. In a CPU with memory mapped I/O, there is no explicit I/O instruction. Which one of the following is true for a CPU with memory mapped I/O?

(A) I/O protection is ensured by operating system routine(s)

(B) I/O protection is ensured by a hardware trap

(C) I/O protection is ensured during system configuration

(D) I/O protection is not possible

Question. 28

What is the swap apace in the disk used for?

(A) Saving temporary html pages

(B) Saving process data

(C) Storing the super-block

(D) Storing device drivers

Question. 29

Increasing the RAM of a computer typically improves performance because

(A) Virtual memory increases

(B) Larger RAMs are faster

(C) Fewer page faults occur

(D) Fewer segmentation faults occur

Question. 30

Consider a three word machine instruction

$$ADD\ A[R_0],@B$$

The first operand (destination) "$A[R0]$" uses indexed addressing mode with $R0$ as the index register. The second operand (source) "@B" uses indirect addressing mode. A and B are memory addresses residing at the second and the third words, respectively. The first word of the instruction specifies the opcode, the index register designation and the source and destination addressing modes. During execution of ADD instruction, the two operands are added and stored in the destination (first operand).

The number of memory cycles needed during the execution cycle of the instruction is

(A) 3 (B) 4

(C) 5 (D) 6

Question. 31

Match **List-I** with **List-II** and select the correct answer using the codes given below the lists:

List-I	List-II
A. $A[1] = B[j];$	**1.** Indirect addressing
B. while $[* A++];$	**2.** Indexed addressing
C. int temp=$*x;$	**3.** Auto increment

Codes:

	A	B	C
(A)	3	2	1
(B)	1	3	2
(C)	2	3	1
(D)	1	2	3

Question. 32

Consider a direct mapped cache of size 32 KB with block size 32 bytes. The CPU generates 32 bit addresses. The number of bits needed for cache indexing and the number of tag bits are respectively

(A) 10,17 (B) 10,22

(C) 15,17 (D) 5,17

Question. 33

A 5 stage pipelined CPU has the following sequence of stages

IF-Instruction fetch from instruction memory.

RD-Instruction decode and register read,

EX- Execute:ALU operation for data and address computation,

MA-Data memory access-for write access the register read at

RD stage it used,

WB-register write back.

Consider the following sequence of instruction:

$I_1 : LR0, \text{Locl};\ R0 <= M[\text{Locl}]$
$I_2 \quad AR0, R0;\ R0 <= R0 + R0$
$I_3 \quad AR2, R0;\ R2 <= R2 - R0$

Let each stage take one clock cycle.

What is the number of clock cycles taken to complete the above sequence of instruction starting from the fetch of I_1?

(A) 8 (B) 10

(C) 12 (D) 15

Question. 34

A device with data transfer rate 10 KB/sec is connected to a CPU. Data is transferred byte-wise. Let the interrupt overhead be 4 μsec. The byte transfer time between the device

interface register and CPU or memory is negligible. What is the minimum performance gain of operating the device under interrupt mode over operating it under program controlled mode?

(A) 15 (B) 25

(C) 35 (D) 45

Question. 35

Consider a disk drive with the following specification

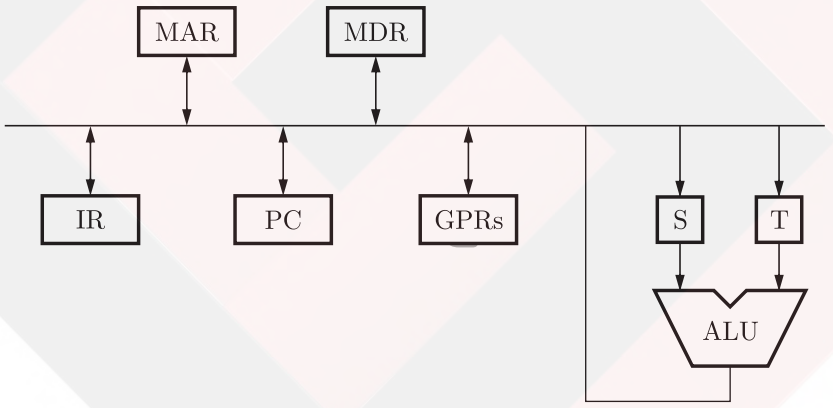
16 surfaces, 512 tracks/surface, 512 sectors/track, 1 KB/sector, rotation speed 3000 *rpm*. The disk is operated in cycle stealing mode whereby whenever one byte word is ready it is sent to memory; similarly, for writing, the disk interface reads a 4 byte word from the memory in each DMA cycle. Memory cycle time is 40 $n$sec. The maximum percentage of time that the CPU gets blocked during DMA operation is

(A) 10 (B) 25

(C) 40 (D) 50

Data for Q. 36 & 37 are given below

Consider the following data path of a CPU



The, ALU, the bus and all the registers in the data path are of identical size. All operations including incrementation of the PC and the GPRs are to be carried out in the ALU. Two clock cycle are needed for memory read operation-the first one for loading data from the memory but into the MDR.

Question. 36

The instruction "add $R0, R1$" has the register transfer in terpretation $R0 <= R0 + R1$. The minimum number of clock cycles needed for execution cycle of this instruction is

(A) 2 (B) 3

(C) 4 (D) 5

Question. 37

The instruction "call Rn, sub" is a two word instruction. Assuming that PC is incremented during the fetch cycle of the first word of the instruction, its register transfer interpretation is

$Rn <= PC = 1;$

$PC <= M[PC];$

The minimum number of CPU clock cycles needed during the execution cycle of this instruction is

(A) 2 (B) 3

(C) 4 (D) 5

Question. 38

A CPU has 24-bit instructions. A program starts at address 300(in decimal). Which one of the following is a legal program counter (all values in decimal)?

(A) 400 (B) 500

(C) 600 (D) 700

Question. 39

Which one of the following is a key factor for preferring B^+-trees to binary search trees for indexing database relation?

(A) Database relations have a large number of record

(B) Database relations are sorted on the primary key

(C) B^+-trees require less memory than binary search trees

(D) Data transfer from disks is in blocks

Question. 40

Which-one of the following statements about normal forms is FALSE?

(A) BCNF is stricter than 3 NF

(B) Loss less, dependency-preserving decomposition into 3 NF is always possible

(C) Loss less, dependency-preserving decomposition into BCNF is always possible

(D) Any relation with two attributes is BCNF

Question. 41

Let r be a relation instance with schema $R = (A, B, C, D)$. WE DEFINE $R_1 = \Pi_{A,B,C}(r)$ and $r_2 = \Pi_{AD}(r)$. let $S = r_1 * r_2$ where * denotes natural join. Given that the decomposition of r into r_1 and r_2 is lossy, which one of the following is TRUE?

(A) $s \subset r$

(B) $r \subset s = r$

(C) $r \subset s$

(D) $r * s = s$

Question. 42

Let E_1 and E_2 be two entities in an E/R diagram with simple single-valued attributes. R_1 and R_2 are two relationships between E_1 and E_2 where R_1 is one-to-many and R_2 is many-to-many. R_1 and R_2 do not have any attributes of their own. What is the minimum number of tables required to represent this situation in the relational model?

(A) 2

(B) 3

(C) 4

(D) 5

Question. 43

The following table has two attributes A and C where A is the primary key and C is the foreign key referencing A with on-delete cascade.

A	C
2	4
3	4
4	3
5	2
7	2
9	5
6	4

The set of all tuples that must be additionally deleted to preserve referential integrity when the tuple (2,4) is deleted is:

(A) (3,4) and (6,4)

(B) (5,2) and (7,2)

(C) (5,2)(7,2) and (9,5)

(D) 1

Question. 44

The relation book (title, price) contains the titles and prices of different books. Assuming that no two books have the same price, what does the following SQL

select title

from book as B

where (select count(*)

from book as T

where T. price>B.Price)<5

(A) Titles of the four most expensive books

(B) Title of the fifth most inexpensive book

(C) Title of the fifth most expensive book

(D) Titles of the five most expensive books

Question. 45

Consider a relation scheme $R = (A, B, C, D, E, H)$ on which the following functional dependencies hold:

$\{A \rightarrow B,.\ BC \rightarrow D,\ E \rightarrow C, D \rightarrow A\}$

What are the candidate keys of R?

(A) AE, BE

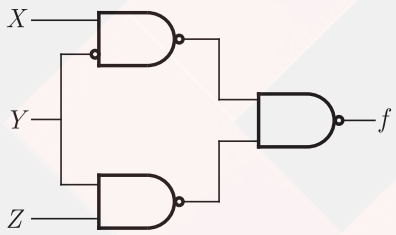
(B) AE, BE, DE

(C) AEH, BEH, BCH

(D) AEH, BEH, DEH

Question. 46

Consider the following circuit.



Which one of the following is TRUE?

(A) f is independent of X

(B) f is independent of Y

(C) f is independent of Z

(D) None of X, Y, Z is redundant

Question. 47

The range of integers that can be represented by an a bit 2's complement number system is

(A) -2^{n-1} to $(2^{n-1}-1)$

(B) $-(2^{n-1}-1)$ to $(2^{n-1}-1)$

(C) -2^{n-1} to 2^{n-1}

(D) $-(2^{n-1}+1)$ to $(2^{n-1}-1)$

Question. 48

The hexadecimal representation of 657_8 is

(A) 1AF

(B) D78

(C) D71 (D) 32F

Question. 49

The switching expression corresponding to

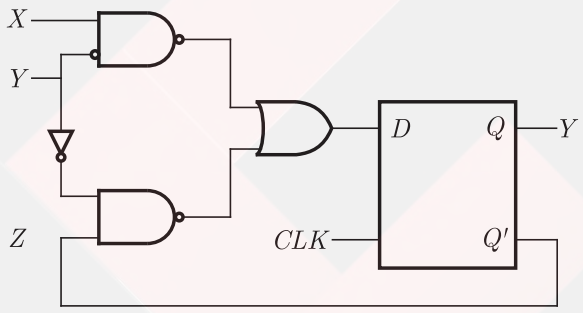
$f(A,B,C,D) = \sum(1,4,5,9,11,12)$ is

(A) $BC'D' + A'C'D + AB'D$ (B) $ABC' + ACF + B'C'D$

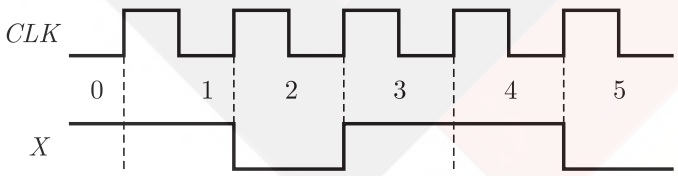
(C) $ACD' + A'BC' + AC'D'$ (D) $A'BD + ACD' + BCD'$

Question. 50

Consider the following circuit involving a positive edge triggered D-FF.



Consider the following timing diagram. Let Ai represent the logic level on the line A in the $i-th$ clock period.



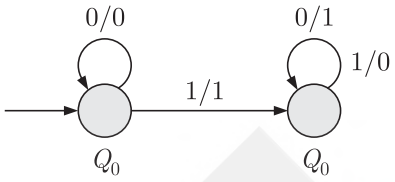
Let A represent the complement of A. The correct output sequence on Y over the clock perids 1 through 5 is

(A) $A_0A_1A_1'A_3A_4$ (B) $A_0A_1A_2'A_3A_4$

(C) $A_1A_2A_2'A_3A_4$ (D) $A_1A_2'A_3A_4A_5$

Question. 51

The following diagram represents a finite state machine which takes as input a binary number from the least significant bit



Which one of the following is TRUE?

(A) It computes 1's complement of the input number

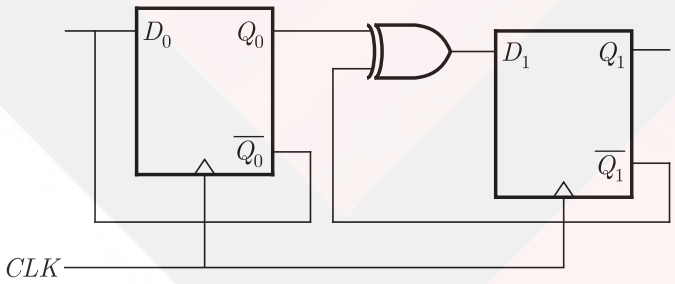
(B) It computes 2's complement of the input number

(C) It increments the input number

(D) It decrements the input number

Question. 52

Consider the following circuit



The flip-flops are positive edge triggered $DFFs$. Each state is designated as a two bit string Q_0, Q_1. Let the initial state be 00. The state transition sequence is

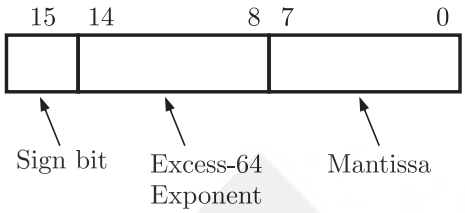
(A) $\underline{00 \rightarrow 11 \rightarrow 01}$ (B) $\underline{00 \rightarrow 11}$

(C) $\underline{00 \rightarrow 10 \rightarrow 01 \rightarrow 11}$ (D) $\underline{00 \rightarrow 11 \rightarrow 01 \rightarrow 10}$

Data for Q. 53 & 54 are given below.

Solve the problems and choose the correct answers.

Consider the following floating point format



Mantissa is a pure fraction is sign-magnitude form.

Question. 53

The decimal number 0.239×2^{13} has the following hexadecimal representation without normalization and rounding off

(A) $0D$ 24

(B) $0D$ $4D$

(C) $4D$ $0D$

(D) $4D$ $3D$

Question. 54

The normalized representation for the above format is specified as follows. The mantissa has an implicit 1 preceding the binary (radix) point. Assume that only 0's are padded in while shifting a field. The normalized representation of the above number (0.239×2^{13}) is

(A) $0A$ 20

(B) 11 34

(C) $4D$ $D0$

(D) $4A$ $E8$

Question. 55

Let $f(x)$ be the continuous probability density function of a random variable X. The probability that $a < X \leq b$, is

(A) $f(b-a)$

(B) $f(b) - f(a)$

(C) $\int_a^b f(x)\,dx$

(D) $\int_a^b xf(x)\,dx$

Question. 56

Let A, B and C be non-empty sets and let $X = (A - B) - C$ and $Y = (A - C) - (B - C)$

Which one of the following is TRUE?

(A) $X = Y$

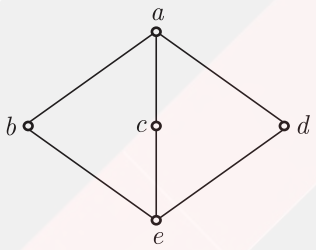
(B) $X \subset Y$

(C) $Y \subset X$

(D) none of these

Question. 57

The following is the Hasse diagram of the poset $[\{a, b, c, d, e\}, \leq]$



The poset is

(A) not a lattice

(B) a lattice but not a distributive lattice

(C) a distributive lattice but not a Boolean algebra

(D) a Boolean algebra

Question. 58

The set {1,2,4,7,8,11,13,14} is a group under multiplication modulo 15. The inverses of 4 and 7 are respectively

(A) 3 and 13

(B) 2 and 11

(C) 4 and 13

(D) 8 and 14

Question. 59

Let G be a simple connected planar graph with 13 vertices and 19 edges. Then, the number of faces in the planar embedding of the graph is

(A) 0 (B) 8

(C) 9 (D) 13

Question. 60

Let G be a simple graph will 20 vertices and 100 edges. The size of the minimum vertex cover of G is 8. Then, the size of the maximum independent set of G is

(A) 12 (B) 8

(C) less than 8 (D) more than 12

Question. 61

Let P, Q and R be three atomic prepositional assertions. Let X denote $(P \vee Q) \rightarrow R$ and Y denote $(P \rightarrow R) \vee (Q \rightarrow R)$. Which one of the following is a tautology?

(A) $X \equiv Y$ (B) $X \rightarrow Y$

(C) $Y \rightarrow X$ (D) $\neg Y \rightarrow X$

Question. 62

What is the first order predicate calculus statement equivalent to the following? Every teacher is liked by some student

(A) $\forall (x)\{\text{teacher } (x) \rightarrow \exists (y)\ [\text{student } (y) \rightarrow \text{likes } (y, x)]]$

(B) $\forall (x)\{\text{teacher } (x) \rightarrow \exists (y)\ [\text{student } (y) \wedge \text{likes } (y, x)]]$

(C) $\exists (y)\ \forall (x)\ \{\text{teacher } (x) \rightarrow [\text{student } (y) \wedge \text{likes } (y, x)]]$

(D) $\forall (x)\ [\text{teacher } (x) \wedge \exists (y)\ [\text{student } (y) \rightarrow \text{likes } (x, y)]]$

Question. 63

Let R and S be any two equivalence relations on a non-empty set A. Which one of the following statements is TRUE?

(A) $R \cap S, R \cup S$ are both equivalence relations

(B) $R \cup S$ is an equivalence relation

(C) $R \cap S$ is an equivalence relations

(D) Neither $R \cup S$ nor $R \cap S$ is an equivalence relation

Question. 64

Let $f: B \rightarrow C$ and $g: A \rightarrow B$ be two function and let $h = f \ o \ g$. Given that h is an onto function. Which one of the following is TRUE?

(A) f and g should both be onto functions

(B) f should be but g need not be onto

(C) g should be onto but f not be onto

(D) both f and g need not be onto

Question. 65

What is the minimum number of ordered pairs of non-negative numbers that should be chosen to ensure that there are two pairs (a, b) and (c, d) in the chosen set such that $a \equiv c \mod 3$ and $b \equiv d \mod 5$

(A) 4 (B) 6

(C) 16 (D) 24

Question. 66

Let $G(x) = 1/(1-x)^2 = \sum_{i=0}^{\infty} g(i)\, x^i$ where $|x| < |$. What is $g(i)$?

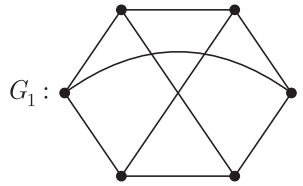
(A) i (B) $i+1$

(C) $2i$ (D) 2^i

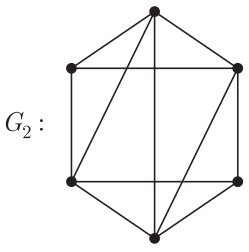
Question. 67

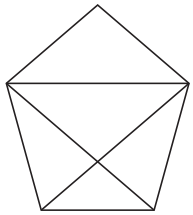
Which one of the following graphs if NOT plannar?

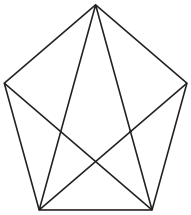
(A)



(B)



(C) G_3 : 

(D) G_4 : 

Data for Q. 68 & 69 are given below.

Solve the problems and choose the correct answers.

Let s and t be two vertices in a undirected graph $G = (V, E)$ having distinct positive edge weights. Let $[X, Y]$ be a partition of V such that $s \in X$ and $t \in Y$. Consider the edge having the minimum weight amongst all those edges that have one vertex in X and one vertex in Y.

Question. 68

The edge e must definitely belong to:

(A) the minimum weighted spanning tree of G

(B) the weighted shortest path from s to t

(C) each path from s to t

(D) the weighted longest path from s to t

Question. 69

Let the weight of an edge e denote the congestion on that edge. The congestion on a path is defined to be the maximum of the congestions on the edges of the path. We wish to find the path from s to t having minimum congestion. Which one of the following paths is always such a path of minimum congestion?

(A) a path from s to t in the minimum weighted spanning tree

(B) a weighted shortest path from s to t

(C) an Euler walk from s to t

(D) a Hamiltonian path from s to t

Question. 70

Consider the set H of all 3×3 matrices of the type

$$\begin{bmatrix} a & f & e \\ 0 & b & d \\ 0 & 0 & c \end{bmatrix}$$

Where a, b, c, d, e and f are real numbers and $abc \neq 0$. Under the matrix multiplication operation, the set H is

(A) a group

(B) a monoid but not group

(C) a semigroup but not a monoid

(D) neither a group nor a semigroup

Question. 71

Consider the following system of equations in three real variables

x_1, x_2 and x_3

$$\begin{aligned} 2x_1 = x_2 + 3x_3 &= 1 \\ 3x_1 - 2x_2 + 5x_3 &= 2 \\ -x_1 - 4x_2 + x_3 &= 3 \end{aligned}$$

This system of equation has

(A) no solution

(B) a unique solution

(C) more than one but a finite number of solutions

(D) an infinite number of solutions

Question. 72

What are the eigenvalues of the following 2×2 matrix?

$$\begin{bmatrix} 2 & -1 \\ -4 & 5 \end{bmatrix}$$

(A) -1 and 1

(B) 1 and 6

(C) 2 and 5

(D) 4 and -1

Question. 73

Suppose n processes, P_1,..... P_n share m identical resource units, which can be reserved and released one at a time. The maximum resource requirement of process P_i is s_p where $s_i < 0$. Which one of the following is a sufficient condition for ensuring that deadlock does not occur?

(A) $\forall i, s < m$

(B) $\forall i, s, < n$

(C) $\sum_{i=1}^{n} s_i < (m+n)$

(D) $\sum_{i=1}^{n} s_i < (m * n)$

Question. 74

Consider the following code fragment:

if (fork()==0

$\{a = a + 5;$ print $f("\%d,\%/\, n"a,$ and $a);\}$

else $\{a - 5;$ print $f("\%d,\%\, d/n", a,\& a);\}$

let u, vbe the values printed by the parent process, and x, y be the values printed by the child process. Which one of the following is TRUE?

(A) $u = x + 10$ and $v = y$

(B) $u = x + 10$ and $v \neq y$

(C) $u + 10 = x$ and v = y

(D) $u + 10 = x$ and v $\neq$ y

Question. 75

What does the following C-statement declare?

```
int(*f)(int*);
```

(A) A function that takes an integer pointer as argument and returns an integer

(B) A function that takes an integer pointer as argument and returns an integer pointer

(C) A pointer to a function that takes an integer pointer as argument an returns

(D) A function that takes an integer pointer as argument returns a function pointer

Question. 76

An Abstract Data type (ADT) is

(A) same as an abstract class

(B) a data type that cannot be instantiated

(C) a data type for which only the operations defined on it can be used, but none else

(D) all of the above

Question. 77

A common property of logic programming languages and functional languages is

(A) both are procedural language

(B) both are based on λ −calculus

(C) both are declarative

(D) all of the above

Question. 78

Which of the following are essential features of an object-oriented programming languages?

1. Abstraction and encapsulation
2. Strictly-typedness
3. Type-safe property coupled with sub-type rule
4. Polymorphism in the presence of inheritance

(A) 1 and 2 only (B) 1 and 4 only

(C) 1, 2 and 4 only (D) 1, 3 and 4 only

Question. 79

A program P reads in 500 integers in the range (0, 100) representing the scores of 500 students. It then prints the frequency of each score above 50. What be the best way for P

to store the frequencies?

(A) An array of 50 numbers

(B) An array of 100 numbers

(C) An array of 500 numbers

(D) A dynamically allocated array of 550 numbers

Question. 80

Consider the following C-program

```
void foo(int n, int sum ){
      int k = 0, j = 0;
if (n == 0) return;
k = n%10; j = n/10;
      sum = sum +k;
      foo (j, sum);
printf("%d,"k);
      }
      int main(){
int a = 2048, sum = 0;
      foo (a, sum);
printf(%d/n",sum);
      }
```

What does the above program print?

(A) 8, 4,0, 2, 14

(B) 8, 4, 0, 2, 0

(C) 2, 0, 4, 8, 14

(D) 2, 0, 4, 8, 0

Question. 81

Consider the following C-program

```
double foo (double); /* Line 1*/
     int main(){
     double da, db;
     // input da
     db =foo(da);
     }
double foo(double a){
     return a;
```

```
}
```

The above code complied without any error or warning. If Line 1 is deleted, the above code will show

(A) no compile warning or error

(B) some complier-warning not leading to unitended results

(C) Some complier-warning due to type-mismatch eventually leading to unitended results

(D) Complier errors

Question. 82

Postorder traversal of a given binary search tree, T produces the following sequence of keys

10, 9, 23, 22, 27, 25, 15, 50, 95, 60, 40, 29

Which one of the following sequences of keys can be the result of an inorder traversal of the tree T?

(A) 9, 10, 15, 22, 23, 25, 27, 29, 40, 50, 60, 95

(B) 9, 10, 15, 22, 40, 50, 60, 95, 23, 25, 27, 29

(C) 29, 15, 9, 10, 25, 22, 23, 27, 40, 60, 50, 95

(D) 95, 50, 60, 40, 27, 23, 22, 25, 10, 0, 15, 29

Question. 83

Consider three decision problem P_1, P_2 and P_3. It is known that P_1 is decidable and P_2 is undecidable. Which one of the following is TRUE?

(A) P_3 is decidable if P_1 is reducible to P_3

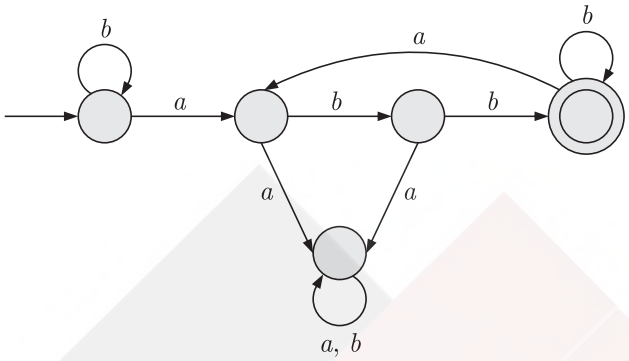
(B) P_3 is undecidable if P_3 is reducible to P_2

(C) $PL3$ is undecidable if P_2 is reducible to P_3

(D) P_3 is decidable if P_3 is reducible to P_2's complement

Question. 84

Consider the machine M



The language recognized by M is

(A) $\{W \in \{a,b\}^* /$ every a in w is followed by exactly two $b's\}$

(B) $\{W \in \{a,b\}^* /$ every a in w is followed by at least two $b's\}$

(C) $\{W \in \{a,b\}^* /$ w contains the substring 'abb'

(D) $\{W \in \{a,b\}^* /$ w does not contain 'aa' as a substring$\}$

Question. 85

Let N_f and N_p denote the classes of languages accepted by non-deterministic finite automata and non-deterministic push-down automata, respectively. let D_f and D_P denote the classes of languages accepted by deterministic finite automata and deterministic push-down automata, respectively. Which one of the following is TRUE?

(A) $D_f \subset N_f$ and $D_P \subset N_P$

(B) $D_f \subset N_f$ and $D_P = N_P$

(C) $D_f = N_f$ and $D_P = N_P$

(D) $D_f = N_f$ and $D_P \subset N_P$

Question. 86

Consider the languages

$L_1 + \{a^n b^n c^m \mid n, m > 0\}$ and $L_2 = \{a^n b^m c^m \mid n, m > 0\}$

(A) $L_1 \cap L_2$ is a context-free language

(B) $L_1 \cup L_2$ is a context-free language

(C) L_1 and L_2 are context-free language

(D) $L_1 \cap L_2$ is a context sensitive language

Question. 87

Let L_1 be a recursive language, and let L_2 be a recursively enumerable but not a recursive language. Which one of the following is TRUE?

(A) $\overline{L_1}$ is recursive and $\overline{L_2}$ is recursively enumerable

(B) $\overline{L_1}$ is recursive and $\overline{L_2}$ is not recursively enumerable

(C) $\overline{L_1}$ and $\overline{L_2}$ are recursively enumerable

(D) $\overline{L_1}$ is recursively enumerable and $\overline{L_2}$ is recursive

Question. 88

Consider the languages

$L_1 = \{ WW^R \mid W \in \{0,1\}^* \}$

$L_2 = \{ W\#W^R \mid W \in \{0,1\}^* \}$, where # is a special symbol

$L_3 = \{ WW \mid W \in \{0,1\}^* \}$

Which one of the following is TRUE?

(A) L1 is a deterministic *CFL*

(B) L_2 is a deterministic *CFL*

(C) L_3 is a *CFL*, but not a deterministic *CFL*

(D) L_3 is a deterministic *CFL*

Question. 89

Consider the following two problems on undirected graphs

α: Given $G(V,E)$, does G have an independent set of size $|V|-4$?

β: Given $G(V,E)$, does G have an independent set of size 5?

Which one of the following is TRUE?

(A) α is in the P and β is NP-complete

(B) α is NP-complete and β is P

(C) Both α and β are NP-complete

(D) Both α and β are in P

****