V.S.B. ENGINEERING COLLEGE, KARUR
Department of Computer Science and Engineering
Class: II Year / III Semester B.E. Computer Science and Engineering

2 Marks Questions

MA8351 - DISCRETE MATHEMATICS

UNIT I - LOGIC AND PROOFS

1. **Express the statement "Good food is not cheap" in symbolic form**.
   Solution : P : food is Good Q : food is Cheap.

   Symbolic form is $P \to \neg Q$

2. **Obtain PDNF for $\neg P \vee Q$.**
   Solution : PDNF is $(P \wedge Q) \vee (\neg P \wedge Q) \vee (\neg P \wedge \neg Q)$

3. **If P, Q & R are statement variables , prove that $P \wedge ((\neg P \wedge Q) \vee (\neg P \wedge \neg Q)) \Rightarrow R$.**
   Solution : Consider $P \wedge ((\neg P \wedge Q) \vee (\neg P \wedge \neg Q)) \to R$

$\Leftrightarrow (F \wedge Q) \vee (F \wedge \neg Q) \to R$

$\Leftrightarrow F \to R$

$\Leftrightarrow \neg F \vee R$

$\Leftrightarrow T \vee R$

$\Leftrightarrow$ T

4. **Prove that whenever $A \wedge B \Rightarrow C$,we also have $A \Rightarrow (B \to C)$ and vice versa**.
   Proof:

   To prove $A \Rightarrow (B \to C)$ we have to prove $A \to (B \to C)$ is a Tautology

$A \wedge B \to C$ is a Tautology

$\Leftrightarrow \neg(A \wedge B) \vee C$ is a Tautology

$\Leftrightarrow \neg A \vee \neg B \vee C$ is a Tautology

$\Leftrightarrow \neg A \vee (B \to C)$ is a Tautology

$\Leftrightarrow A \to (B \to C)$ is a Tautology. Hence the proof.

5. **Define functionally complete set of connectives and give an example.**
   A collection of logical operators is called functionally complete if every compound proposition is logically equivalent to a compound proposition involving only those logical operators

6. **Define Contra positive of a statement.**

For any statement formula $P \to Q$, the statement formula $Q \to P$ is called its converse, $\neg P \to \neg Q$ is called its inverse and $\neg Q \to \neg P$ is called its contrapositive.

7. **Give the converse and the Contra positve of the implication " If it is raining then I get wet".**

Solution :

P : It is raining Q : I get wet

Converse : $Q \to P$: If I get wet, then it is raining.

Contrapositive : $\neg Q \to \neg P$: If I do not get wet, then it is not raining

8. **Show that $\neg(P \wedge Q) \to (\neg P \vee (\neg P \vee Q)) \Leftrightarrow (\neg P \vee Q)$. (Use only the laws).**

Solution :

$\neg(P \wedge Q) \to (\neg P \vee (\neg P \vee Q))$

$\Leftrightarrow \neg\neg(P \wedge Q) \vee (\neg P \vee (\neg P \vee Q))$

$\Leftrightarrow (P \wedge Q) \vee (\neg P \vee Q)$ (Associative law)

$\Leftrightarrow (P \vee \neg P \vee Q) \wedge (Q \vee \neg P \vee Q)$ (Distributive law)

$\Leftrightarrow (T \vee Q) \wedge (\neg P \vee Q)$ (Negation law)

$\Leftrightarrow T \wedge (\neg P \vee Q)$ (Domination law)

$\Leftrightarrow (\neg P \vee Q)$ (Identity law)

9. **Write the following statement in symbolic form**

(a) Mark is poor but unhappy

(b) mark is rich or unhappy

(c)Mark is neither rich nor happy

(d) Mark is poor (or) he is both rich and poor.

Solution :

M : Mark is poor H : Mark is happy

The symbolic forms are

(a) $M \wedge \neg H$ (b) $M \vee \neg H$ (c) $\neg M \vee \neg H$ (d) $M \vee (\neg M \wedge \neg H)$

10. **Write the following statement in symbolic form**

"x is the father of mother of *y*" .

Solution :

P(x) x is a person

F(x,y) : x is the father of y

M(x,y) : x is the mother of y

The symbolic form is $(\exists z)P(z)\wedge F(x,z)\wedge M(z,y)$

11. Write in symbolic form the statement " The house will be destroyed if there is a flood".

Solution :

P : House will be destroyed Q : There is flood

The symbolic form is $Q\to P$.

12. Construct the truth table for $(P\to Q)\wedge(Q\to P)$.

P	Q	$P\to Q$	$Q\to P$	$(P\to Q)\wedge(Q\to P)$
T	T	T	T	T
T	F	F	T	F
F	T	T	F	F
F	F	T	T	T

13. Write the dual of $P\,\overline{\vee}\,Q$.

Solution :

$P\,\overline{\vee}\,Q \Leftrightarrow (P\wedge\neg Q)\vee(\neg P\wedge Q)$

Dual of $P\,\overline{\vee}\,Q$ is $(P\vee\neg Q)\wedge(\neg P\vee Q)$

14. Represent $P\to Q$ using $\uparrow$ only.

$P\to Q\Rightarrow\neg P\vee Q$

$\Rightarrow\neg(P\wedge\neg Q)$

$\Rightarrow P\uparrow\neg Q$

15. Write the converse, inverse and contra positive of the following "If today is labour day, then tomorrow is Tuesday".

Solution :

P : Today is Labour day Q : Tomorrow is Tuesday

Converse : $Q\to P$: If tomorrow is Tuesday then today is labour day.

Inverse : $\neg P\to\neg Q$: If today is not labour day then tomorrow is not Tuesday.

Contrapositive : $\neg Q \to \neg P$: If tomorrow is not Tuesday then today is not labour day

16. For any statements P,Q prove that $\neg(P \downarrow Q) \Leftrightarrow \neg P \uparrow \neg Q; \neg(P \downarrow Q) \Leftrightarrow \neg P \downarrow \neg Q$.

Solution :

$$\neg(P \downarrow Q) \Leftrightarrow \neg(\neg(P \vee Q)) \quad \neg(P \uparrow Q) \Leftrightarrow \neg(\neg(P \wedge Q))$$

$$\Leftrightarrow \neg(\neg P \wedge \neg Q) \Leftrightarrow \neg(\neg P \vee \neg Q)$$

$$\Leftrightarrow \neg P \uparrow \neg Q \qquad \Leftrightarrow \neg P \downarrow \neg Q$$

17. Determine the truth value of the following

a) If 3+4=12 , then 3+2=6.

b) If 3+3=6 , then 3+4=9.

a) Here 3+4=12 : F & 3+2=6 : F. ie $F \to F$ so truth value is <u>True</u>

b) Here 3+3=6 : T & 3+2=6 : F. ie $T \to F$ so truth value is <u>False</u>

18. Write the dual of (a) $Q \to P$ (b) $P \to (Q \wedge R)$ (c) $P \leftrightarrow Q$.

Solution :

a) $Q \to P$ **b)** $P \to (Q \wedge R)$ **c)** $P \leftrightarrow Q$

$$\Rightarrow \neg Q \vee P \quad \Rightarrow \neg P \vee (Q \vee R) \quad \begin{array}{l} \Rightarrow (P \to Q) \wedge (Q \to P) \\ \Rightarrow (\neg P \vee Q) \wedge (\neg Q \vee P) \end{array}$$

Dual : $\neg Q \wedge P$ Dual : $\neg P \wedge (Q \vee R)$ Dual : $(\neg P \wedge Q) \vee (\neg Q \wedge P)$

19. Show that $\{\wedge,\vee\},\{\vee\}\,\&\,\{\neg\}$ are not functionally complete set.

Solution :

$\neg P$ cannot be expressed using the connectives $\{\vee,\wedge\}$, since no such contribution of statement exist with $\{\vee,\wedge\}$ as input is T and the output is F.

20. Express $P \uparrow Q$ interms of $\downarrow$ only.

Solution :

$$P \uparrow Q \Leftrightarrow \neg(P \wedge Q)$$

$$\Leftrightarrow \neg P \vee \neg Q \Leftrightarrow (P \downarrow P) \vee (Q \downarrow Q) \Leftrightarrow (P \downarrow P) \downarrow (Q \downarrow Q)$$

21. Show that $P \to (Q \to R) \Leftrightarrow P \to (\neg Q \vee R) \Leftrightarrow (P \wedge Q) \to R$.

$$P \to (Q \to R) \Leftrightarrow P \to (\neg Q \vee R)$$

$$\Leftrightarrow \neg P \vee \neg Q \vee R \Leftrightarrow \neg(P \wedge Q) \vee R \Leftrightarrow (P \wedge Q) \to R$$

22. Demonstrate that R is a valid inference from the premises $P \to Q, Q \to R \,\&\, P$.

Step	Derivation	Rule
(1)	$P \to Q$	P
(2)	$Q \to R$	P
(1,2)	$P \to R$	T
(3)	P	P
(1,2,3)	R	T

23. Show that $\neg Q, P \to Q \Rightarrow \neg P$.

Step	Derivation	Rule
(1)	$\neg Q$	P
(2)	$P \to Q$	P
(1,2)	$\neg Q \to \neg P$	T
(1,2)	$\neg P$	T

24. Show that a) $P \vee (P \wedge Q) \Rightarrow P$ b) $P \vee (\neg P \wedge Q) \Leftrightarrow P \vee Q$.

a) $P \vee (P \wedge Q) \to P \Leftrightarrow \left[\neg\left(P \vee (P \wedge Q)\right)\right] \vee P \Leftrightarrow \left[\neg P \vee \neg(P \wedge Q)\right] \vee P$

$\Leftrightarrow \left[\neg P \vee \left(\neg P \vee \neg Q\right)\right] \vee P \Leftrightarrow \left(\neg P \wedge \neg P\right) \vee \left(\neg P \wedge \neg Q\right) \vee P$

$\Leftrightarrow \neg P \vee \left(\neg P \wedge \neg Q\right) \vee P \Leftrightarrow \neg P \vee P \vee \left(\neg P \wedge \neg Q\right)$

$\Leftrightarrow T \vee \left(\neg P \wedge \neg Q\right) \Leftrightarrow T$

b) $P \vee (\neg P \wedge Q) \Leftrightarrow \left(P \vee \neg P\right) \wedge \left(P \vee Q\right) \Leftrightarrow T \wedge \left(P \vee Q\right) \Leftrightarrow \left(P \vee Q\right)$

25. Give an example to show that $(\exists x)(A(x) \wedge B(x))$ need not be a conclusion from $(\exists x)A(x) \& (\exists x)B(x)$.

Solution :

Let $A(x): x \in A$. Similarly $B(x)$ is defined.

Let A={1} and B={2}.

Since A and B are non-empty $(\exists x)A(x)$ and $(\exists x)B(x)$ is True.

But $(\exists x)\left(A(x) \wedge B(x)\right)$ is False.

26. Let p(x) denote the statement "x>4". What are the truth values of P(5) and P(2)?

Solution :

We obtain the statement P(5) by setting x=5 in the statement "x>4". Hence P(5), which is the statement "5>4" is true. However P(2), which is the statement "2>4" is false.

27. Let Q(x,y) denote the statement "x=y+2", what are the truth values of the prepositions Q(1,2) and Q(2,0).

Solution :

To obtain Q(1,2), set x=1 and y=2 in the statement Q(x,y).

Hence Q(1,2) is the statement "1=2+2" which is false.

Similarly for Q(2,0), the statement is "2=0+2" which is True.

28. What are the truth values of the preposition R(1,2,3) and R(0,0,1)?

Solution :

The preposition R(1,2,3) is obtained by setting x=1, y=2 and z=3 in the statement R(x,y,z) which denote "x+y=z".

The preposition R(1,2,3) is "1+2=3" which is True.

The preposition R(0,0,1) is "0+0=1" which is False.

29. Find the truth value of $(x)(P \to Q(x)) \vee (\exists x)R(x)$ where $P: 2>1, Q(x): x>3, R(x): x>4$ with universe of discourse E being E={2,3,4}.

Solution :

$P: 2>1$ is True , $Q(4)$ is False. Therefore $(x)(P \to Q(x))$ is False.

Since R(2), R(3), R(4) are all False, $(\exists x)R(x)$ is also False.

Hence $(x)(P \to Q(x)) \vee (\exists x)R(x)$ is also False.

30. Express the statement " For every *x* there exist a *y* such that $x^2 + y^2 \geq 100$" in symbolic form.

The symbolic form is $(\forall x)(\exists y)(x^2 + y^2 \geq 100)$

31. Define Simple statement function. (OR)
Define statement function of one variable. When it will become a statement?

A simple statement function of a variable is defined to be an expression consisting of a predicate symbol and an individual variable. Such a statement function becomes a statement when the variable is replaced by the name of any object.

Example : If "X is a Teacher" is denoted by T(x), it is a statement function. If X is replaced by John, then "John is a teacher".

32. Give the symbolic form of the statement

"Every book with a blue cover is a Mathematics book".

The symbolic form is $(\forall x)(S(x)) \rightarrow P(x)$

where S(x) : x is every book with a blue cover

P(x) : Mathematics book.

33. Define Quantifiers.

Certain declarative sentences involve words that indicate quantity such as "all, some, none, one". These words help to determine the answer to the question "How many?" Since such words indicate quantity they are called quantifiers.

34. Write the following sentence in a symbolic form "Every one who is healthy can do all kinds of work".

H(x) : x is a healthy person

H(y) : y is a kind of work

D(x,y) : x can do y

$(x)(y)[H(x) \wedge H(y) \rightarrow D(x,y)]$

35. Symbolize the following statement with and without using the set of positive integer on the universe of discourse

"Given any positive integers , there is a greater positive integer".

Solution:

Let the variable x and y be restricted to the set of positive integers. Then theabove statement can be

Paraphrased as follows:

For all x, there exist a y such that y is greater than x. If G(x,y) is "x is greater than y", then the

given statement is $(x)(\exists y)G(y,x)$.

If we do not impose the restriction on the universe of discourse and if we write P(x) for "x is a

positive integer", then we can symbolize the given statement is $(x)(P(x) \rightarrow (y)(P(y) \wedge G(y,x)))$

36. Rewrite the following using quantifiers. "Some men are genius"

M(x) : x is a manG(x) : x is genius

$(\exists x)(M(x) \wedge G(x))$

37. Symbolize the expression " All the world loves a lover"

In first note that the quotation really means that everybody loves a lover. Now

Let P(x): x is a personL(x) : x is a loverR(x,y) : x loves y

The required expression is $(x)(P(x)) \rightarrow (y)(P(y) \wedge (L(y) \rightarrow R(x,y)))$

38. Identify the bound variables and the free variables in each of the following expressions (a) $(x)(\exists z)(\cos(x+y)) = \sin(z-x)$**.(b)** $(\exists x)(\exists y)(x^2 - y^2 = z)$.

Solution:

In (a) the scope of $(x)(\exists z)$ is $(\cos(x+y))$, while the occurrence of y is a free occurrence and

$\sin(z-x)$ is free.

In (b) the scope of $(\exists x)(\exists y)$ is x^2-y^2, while the occurrence of z is a free occurrence.

39. Use quantifiers to express the associate law for multiplication of real numbers.

Solution: $\forall x\ \forall y\ \forall z\left(\left(x.y\right).z = x.\left(y.z\right)\right)$ where the universe of discourse for x,y,z is

the set of real numbers.

40. Let the universe of discourse be E={5,6,7}. Let A={5,6} and B={6,7}. Let P(x) : x is in A; Q(x) : x is in B and R(x,y) : x+y<12. Find the truth value of $\left((\exists x)\left(P(x)\rightarrow Q(x)\right)\right)\rightarrow R(5,6)$.

Solution: $R(x,y): x+y<12$ the only possibility is

5 + 6 < 12

$\therefore x\left(P(x)\rightarrow Q(x)\right)$ is true.

$\therefore\left((\exists x)\left(P(x)\rightarrow Q(x)\right)\right)\rightarrow R(5,6)$

41. Give an example in which $(\exists x)\left(P(x)\rightarrow Q(x)\right)$ **is true but** $\left((\exists x)P(x)\right)\rightarrow\left((\exists x)Q(x)\right)$ **is false.**

Solution : Let E = {2,3,5}

Let P(x) : x < 4, Q(x) : x > 6

P(2) is true. $\therefore(\exists x)P(x)$ is true.

For any x in E, Q(x) is false.

Hence $\left((\exists x)P(x)\right)\rightarrow\left((\exists x)Q(x)\right)$ is false.

P(5) is false and Q(5) is false.

$\therefore P(5)\rightarrow Q(5)$ is true.

$\therefore(\exists x)\left(P(x)\rightarrow Q(x)\right)$ is true.

42. Construct a truth table for $(p\rightarrow q)\rightarrow(q\rightarrow p)$

p	q	$p\rightarrow q$	$q\rightarrow p$	$(p\rightarrow q)\rightarrow(q\rightarrow q)$
T	T	T	T	T
T	F	F	T	T
F	T	T	F	F
F	F	T	T	T

UNIT-II – COMBINATORICS

1. Define the product rule.

If one job can be done in m ways and following this another job can be done in n ways then the total number of ways in which both the jobs can be done in the stated order is mn.

2. Define the sum rule.

If one job can be done in m ways and another job can be done in n ways and if there is no way common to both jobs then the total number of ways in which either of the two jobs can be done is equal to m + n.

3.How many different 8-bit strings are there that begin and end with one.

Solution: A 8-bit string that beings and with 1 can be constructed in 6 steps,(i.e.,) By selecting IInd bit,IIIrd bit,IVbit,Vth bit,VIth bit and VIIth bits and each bit Can be selected in 2 ways.

Hence, the total number of 8-bit strings that begins and end with 1 is equal to 2.2.2.2.2= 2^6 =64.

4. How many different 8-bit strings are there that end with 0111?

Solution: A 8-bit strings that end with 0111 can be constructed in 4 steps.

By selection Ist bit,IInd bit,IIIrd bit and IVth bit and each bit can be selected in 2 Ways.

The total number of 8-bit strings that end with 0111 is equal to 2.2.2.2= 2^4 =16.

5.What is Inclusion and Exclusion principle.

Let $P_1, P_2, ...P_n$ are finite sets.

Then $\left|P_1 \cup P_2 \cup .....P_n\right| = \sum_{1 \le i \le n} \left|P_i\right| - \sum_{1 \le i < j \le n} \left|P_i \cap P_j\right| + \sum_{1 \le i < j < k \le n} \left|P_i \cap P_j \cap P_k\right| .... + (-1)^{n-1} \left|P_1 \cap P_2 \cap ...P_n\right|$

6.Define Pigeonhole principle.

It states that if there are more pigeons(objects)than the pigeonholes(boxes),then some pigeonhole(box) must contain two or more pigeons(objects).the pigeonhole principle is also called the Dirichlet drawer principle or shoe box principle.

7. Give two example based on pigeonhole principle.

Solution:

1.Among any group of 365 people, there must be atleast two with the same birthday, because there are only 366 maximum possible birthdays.

2. In any group of 27 English words, there must be atleast two that starts with the same letter, since there are 26 letters in English alphabet.

8. Show that among 13 children, there atleast two children who were born in the same month.

Solution: let us assume that 13 children as pigeons and the 12 months (January, …… December)as the pigeonholes then by the pigeonhole principle there will be atleast two children who were born in the same month.

9. Prove the statement: If m= K_{n+1} pigeons(where K $\geq$ 1)occupy n pigeonholes then atleast one pigeonhole must contain K+1 or more pigeons.

Solution: Let us assume that the conclusion of the given statement is false.

Then every pigeonhole contains K or less number of pigeons. Then, the total number of pigeons would be nK. This is a contradiction. Hence, the assumption made is wrong, and the given statement is true.

10.Show that if seven colors are used to paint 50 cars, atleast eight cars will have the same colour.

Solution: Assume that 50 cars (pigeons)are assign 7 colors (pigeonholes).Hence, by the generalised pigeonhole principle, atleast $\left[\frac{50-1}{7}\right]+1=8$ cars will have the same colour.

11.Show that if any 5 numbers from 1 to 8 are chosen, then two of them will have their sum equal to 9.

Solution: let us consider the following sets :

$A_1=\{1,8\}, A_2=\{2,7\}, A_3=\{3,6\}, A_4=\{4,5\}$

These are the only sets containing two numbers from 1 to 8, whose sum is 9.

Because every number from 1 to 8 belongs to one of the above sets, each of the 5 numbers chose must belong to one of the sets.

Since there are only 4 sets, two of the 5 chosen numbers have to belong to the same set (by the pigeonhole principle. These two numbers have their sum equal to 9.

12. Define permutation:

A permutation of a set of distinct objects is an ordered arrangement of these objects.

Note: Permutation means selection and arrangement of factors.

Notation: nP_r (or) P(n, r) (or) $P_{n,r}$ (or) $P_n^{\,r}$ (or) $(n)_r$

13. Define r-permutation.

An r-permutation of n(distinct) elements $x_1, x_2, ...x_n$ is an ordering of an r-elements subset $\{x_1, x_2, ...x_n\}$ .the number of r-permutations of a set of n distinct elements is denoted by P(n.r).

14. Define combinations and give an example.

A combination is a selection of objects without regard to order .(or) A combination is an unordered collection of distinct objects.

Example: abc is the combination of three objects a, b and c.

15. Prove that for let n and r be the non-negative integers with $r \leq n$. **Then** $C(n,r)=C(n,n-r)$ **.**

Proof: We know that $C(n,r)=\dfrac{n!}{r!(n-r)!}$

$$C(n,n-r)=\frac{n!}{(n-r)!(n-(n-r))!}=\frac{n!}{(n-r)!(r!)}=C(n,r)$$

Hence, C(n , r)=C(n, n -r).

16. Determine the value of n if $20C_{n+1}=20C_{2n-1}$**.**

Solution: Given: $20C_{n+2}=20C_{2n-1}$

Formula $nC_x=nC_y \Rightarrow n=x+y$ or x=y

n+2=2n-1 $\Rightarrow$ 3=n $\Rightarrow$ n=3

17. How many possibilities are there for the win, place and show (first, second and third) positions in a horse race with 12 horses if all orders of finish are possible?

Solution: The number of ways to pick the three winners is the number of ordered selections of three elements from 12. (i.e.,) P(12,3)=(12)(11)(10)=1320.

18. Determine the value of n if (4) $(nP_3)=(n+1)P_3$

Solution: Given:

$$(4)(nP_3)=(n+1)P_3$$

$$(4)\left[\frac{n!}{(n-3)!}\right]=\frac{(n+1)!}{(n+1-3)!}=\frac{(n!)(n+1)}{(n-3)!(n-2)!}$$

$$\Rightarrow 4=\frac{n+1}{n-2} \quad \Rightarrow 4(n-2)=n+1 \quad \Rightarrow 4n-8=n+1$$

$\Rightarrow$3n=9 $\Rightarrow$ n=3

19. In how many ways can a set of five letter to be selected from the English alphabet?

Solution: The positions of r 1s in a b it string of length n from an r-combination of the set $\{1,2,3,...n\}$. Hence, there are C(n ,r) bit strings of length n that contain exactly r 1s.

20. Define Recurrence Relations.

Recurrence Relation:(Sometimes called difference equation).

A recurrence relation for the sequence $\{a_n\}$ is an equation that shows a_n in terms of one or more of the previous terms of the sequence $a_0,a_1,...a_{n-1}$, for all integers n with n$\geq n_0$,where n_0 is a non-negative integer.

21.Let $\{A_n\}$ be a sequence that satisfies the recurrence relation $a_n = a_{n-2} + a_{n-1}$ for n=1,2,3,4,5,….and suppose that $a_0 = 3$ and $a_1 = 5$ .Whatare a_2 and a_3 ?

Solution: Given

$$a_n = a_{n-2} + a_{n-1}$$
$$a_2 = a_0 + a_1 = 3 + 5 = 8$$
$$a_3 = a_1 + a_2 = 5 + 8 = 13$$

22. Let $a_n = 2^n + (5)(3^n)$ for n=0, 1,2,….

(a) Find a_0, a_1 and a_2. (b) Show that $a_4 = 5a_3 - 6a_2$.

Solution: Given: $a_n = 2^n + (5)(3^n)$

$$a_0 = 2^0 + (5)(3^0) = 1 + (5)(1) = 6$$
$$a_1 = 2^1 + (5)(3^1) = 2 + (5)(3) = 17$$
$$a_2 = 2^2 + (5)(3^2) = 4 + (5)(9) = 49$$

(b) Given: $a_n = 2^n + 5(3^n)$

$$a_3 = 2^3 + 5(3^3) = 8 + 5(27) = 143$$

To prove: $a_4 = 5a_3 - 6a_2$

$$L.H.S = a_4 = 2^4 + 5(3^4) = 16 + 5(81) = 421$$
$$R.H.S = 5a_3 - 6a_2 = 5(143) - 6(49) = 715 - 294 = 421$$
$$L.H.S = R.H.S.$$

Hence the proof.

23. What are the three methods to solve recurrence relation?

1. Iteration,2. Characteristic roots and 3.Generating functions.

24. What are the solution of the recurrence relation $a_n = 2a_{n-1}$ $for\ n \geq 1, a_0 = 3$

Solution: Given : $a_n = 2a_{n-1}$

(i.e.,) $a_n - 2a_{n-1} = 0$ …… (1)

Let $a_n = r^n$ be a solution of (1)

$$:\Rightarrow r^n - 2r^{n-1} = 0 \quad \Rightarrow r^n\left[1 - \frac{2}{r}\right] = 0 \quad \Rightarrow r^n\left[\frac{r-2}{r}\right] = 0$$

The characteristic equation is r-2=0

r=2

By theorem $a_n = \alpha 2^n$ ……..(2)

$$a_0 = 3 \Rightarrow a_0 = \alpha 2^0 = 3$$

Given $\Rightarrow \alpha = 3$

$$(2) \Rightarrow a_n = 3(2^n)$$

25. Define Generating functions.

The generating function for the sequence $a_0, a_1, ...a_k, ...$ of real numbers is the infinite series.

G(x) = $a_0 + a_1 x + ... + a_k x^k + ... = \sum_{k=0}^{\infty} a_k x^k$.

26. Find the generating function for the finite sequence 2,2,2,2,2.

Solution: The generating function of 2,2,2,2,2. is $2 + 2x + 2x^2 + 2x^3 + 2x^4$

$$= 2\left[1 + x + x^2 + x^3 + x^4\right] = 2\left[\frac{x^5 - 1}{x - 1}\right]$$

When $x \neq 1$.Consequently, G(x)=2$\left[\frac{x^5 - 1}{x - 1}\right]$ is the G.F. of the sequence 2,2,2,2,2.

27. Find the generating function for $(1+x)^{-n}$ **,where n is a positive integer.**

Solution: $(1+x)^{-n} = \sum_{k=0}^{n} (k^{-n}) x^k$ by extended binomial theorem.

We know that $\left(r^{-n}\right) = (-1)^r c(n + r - 1, r)$

$$(1+x)^{-n} = \sum_{k=0}^{n} (-1)^k c(n + k - 1, k) x^k.$$

28. Find a closed form for the generating function of 3,-3,3,-3,3,-3,….

Solution: We have $\frac{3}{1+x} = 3(1+x)^{-1} = 3(1 - x + x^2 - x^3 + ...)$

$$= 3 + (-3)x + 3x^2 + (-3)x^3 + ... = \sum_{n=0}^{\infty} (-3)^n x^n$$

Hence the required G.F is $\frac{3}{1+x}$

29.Find the co-efficient of x^{10} **in** $(1 + x^5 + x^{10} + x^{15} + ...)^3$

Solution: We know that $(1 + x^5 + x^{10} + x^{15} + ...)^3 = \left[(1 - x^5)^{-1}\right]^3 = (1 - x^5)^{-3} = \sum c(3 + r - 1, r) x^{5r}$

To find the coefficient of x^{10}, put 5r=10 =>r=2

The required coefficient is c(3+2-1,2)=c(4,2)

$$= 4c_2 = 6$$

30.Define Inclusion and Exclusion.

Let X and Y be two finite subsets of a universal set U. If X and Y are disjoint, then

$|X \cup Y| = |X| + |Y|$. If X and Y are not disjoint then $|X \cup Y| = |X| + |Y| - |X \cap Y|$

This is called the principle of inclusion and exclusion.

31.Give a formula for the number of elements in the union of four sets.

Solution: By the principle of the inclusion and exclusion we get

$$\begin{aligned}|A_1 \cup A_2 \cup A_3 \cup A_4| = {} & |A_1| + |A_2| + |A_3| + |A_4| - |A_1 \cap A_2| \\ & - |A_1 \cap A_3| - |A_1 \cap A_4| - |A_2 \cap A_3| - |A_2 \cap A_4| - |A_3 \cap A_4| \\ & + |A_1 \cap A_2 \cap A_3| + |A_1 \cap A_2 \cap A_4| + |A_1 \cap A_3 \cap A_4| \\ & + |A_2 \cap A_3 \cap A_4| - |A_1 \cap A_2 \cap A_3 \cap A_4|\end{aligned}$$

32. Find a formula for the probability of the union of n events in a sample space.

Solution: the probability of n events in a sample space is

$$P\left(\bigcup_{i=1}^{n} E_i\right) = \sum_{1 \le i \le n} P(E_i) - \underset{1 \le i < j \le n}{E} P(E_i \cap E_j) + \sum_{1 \le i < j < k \le n} P(E_i \cap E_j \cap E_k) - \ldots\ldots + (-1)^{n+1} p(\bigcap_{i=1}^{n} E_i)$$

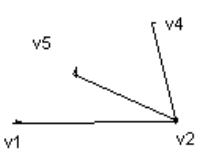
UNIT-III - GRAPHS

1. Define Graph.

A graph G = (V(G),E(G)) consists of V, a non empty set of vertices (nodes or points)and E, a set of edges (also called lines).

2. Define adjacent vertices.

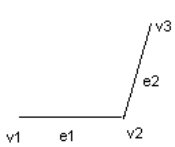
Any pair of vertices which are connected by an edge in a graph is called adjacent vertices.



Here $v_1, v_2; v_2, v_4; v_2, v_3$ are adjacent vertices $v_1, v_3; v_3, v_4; v_1, v_4$ are not adjacent.

3. Define adjacent edges.

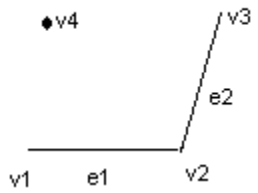
If two distinct edges are incident with a common vertex then they are called adjacent edges.



Here e_1 and e_2 are incident with a common vertex v_2.

4. Define isolated vertex

In any graph , a vertex which is not adjacent to any other vertex is called an isolated vertex. Otherwise the vertex has no incident edge.



Here v_3 has no incident edge. Therefore the vertex v_3 is called isolated vertex.

5. Define Label graph.

A graph in which each vertex is assigned a unique name or label is called a label graph.

6. Define Directed graph and undirected graph.

In a graph G(V,E), an edge which is associated with an ordered pair of vertices is called a directed edge of graph G, While an edge which is associated with an unordered pair of vertices is called an undirected edge.

A graph in which every edge is directed is called a directed graph or simply a digraph.

7. Draw a diagram for the following graph

Solution:

$$G = G(V, E)$$
$$V = \{v_1, v_2, v_3, v_4\}$$
$$E = \{(v_1, v_2), (v_4, v_1), (v_3, v_1), (v_3, v_4)\}$$

8. Define Niche overlap Graphs in Ecology.

A niche overlap graph is a simple graph because no loops or multiple edge are needed in this model.

9. Define the degree of a vertex.

The degree of a vertex in an undirected graph is the number of edges incident with it, except that a loop at a vertex contributes twice to the degree of that vertex.

The degree of the vertex is denoted by deg( ).

10. Define adjacent vertices in undirected graph.

Two vertices u and v in an undirected graph G are called adjacent (or neighbors) in g u, v are endpoints of an edge of G.

11. How many edges are there in a graph with 10 vertices each of degree six?

Solution: Sum of the degree of the 10 vertices is (6)(10)=60 i.e., 2e=60 e=30.

12. Show that the sum of degree of all the vertices in a graph G, is even.

Proof: Each edge contributes two degree in a graph.

Also, each edge contributes one degree to each of the vertices on which it is incident.

Hence, if there are N edges in G, then

$$2N = d(v_1) + d(v_2) + .. + d(v_N)$$

Thus, 2N is always even.

13. Define In degree.

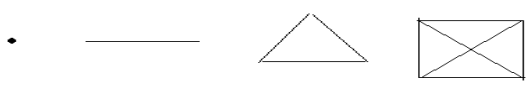
In a directed graph G, the in degree of v denoted by in deg G(v) or $\deg^{-1}{}_G(v)$,is the number of edges ending at v.

14. Define out degree.

In a directed graph G, the out degree of v of G denoted by out $\deg_G(v)$ or $\deg_G^+(v)$, is the number of edges beginning at v.

15.Draw Graphs K_n for $1 \le n \le 4$

Solution:



16. What is the degree sequence of K_n , Where n is a positive integer? Explain your answer.

Solution: Each of the n vertices is adjacent to each of the other n-1 vertices, so the degree sequence is n-1,n-1, ….,n-1(n terms)

17. Define Cycle Graph.

A cycle graph of order 'n' is a connected graph whose edges from a cycle of length 'n' and denoted by C_n .

18. Define Wheel graph.

A Wheel graph of order n is obtained by joining a new vertex called 'Hub' to each vertex of a cycle graph of order n-1, denoted by W_n .

19. Define Regular graph.

A graph in which all vertices are of equal degree is called a regular graph.

If the degree of each vertex is r, then the graph is called a regular graph of degree r.

20. For Which value of n are these graphs regular?

(a) K_n (b) C_n (c) W_n (d) Q_n

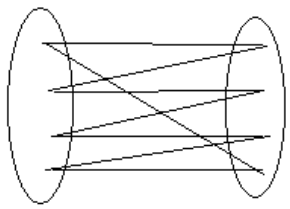
Solution:(a) For all $n \ge 1$ (b) For all $n \ge 3$ (c) For n=3 (d) For all $n \ge 0$

21. Define bipartite graph.

A bipartite graph is an undirected graph whose set vertices can be partitioned into two sets M and N is such a way that each edge joins a vertex in M to a vertex in N and no edge joints either two vertices in M or two vertices in N.

Here $V = M \bigcup N$ $\quad M \bigcap N = \phi$

$M = \{v_1, v_3, v_5, v_7\}$ $V = \{v_2, v_4, v_6, v_8\}$



22. Define Complete Bipartite graph.

A complete bipartite graph is a bipartite graph in which every vertex of M is adjacent to every vertex of N. the complete bipartite graphs that may be partitioned into sets M and N as above s.t M=m and $|N| = n$ are denoted by $K_{m,n}$

23. Define star graph.

Any graph that is $K_{1,n}$ is called a star graph.

24. Prove that a graph which contains a triangle can not be bipartite.

Proof: Atleast two of the three vertices must lie in one of the bipartite sets because there two are joined by edge, he graph can not be bipartite.

25. Define Graph coloring.

The assign of colors to the vertices of G, one color to each vertex, so that adjacent vertices are assigned different color is called the proper coloring of G or simply vertex coloring.

If G has n coloring, then G is said to be n-colorable.

26. Define Subgraph.

A subgraph of a graph G=(V,E) is a graph H=(W,F), where $W \subseteq V$ and $F \subseteq E$. A subgroph H of G is a proper subgraph of G if $H \neq G$.

27. Define Complement.

The complement $\overline{G}$ of G is defined as a simple graph with the same vertex set as G and value two vertices u and v are adjacent only when then are not adjacent in G.

28. Define Adjancy matrix.

Let G (V, E) be a simple graph with n. vertices ordered from V_1 and V_n ,then the adjacency

matrix A=$\left[a_{ij}\right]_{n\times n}$ of G is an n$\times$n symmetric matrix defined by the elements.

$$a_{ij}=\begin{cases}1 & \text{when } V_1 \text{ is adjacent to } V_j\\ 0 & \text{Otherwise}\end{cases}$$

it is denoted by A(G) or A_G

$$A_G=\begin{array}{c}\\ V_1\\ V_2\\ V_3\\ V_4\end{array}\begin{pmatrix}V_1 & V_2 & V_3 & V_4\\ 0 & 1 & 1 & 1\\ 1 & 0 & 1 & 1\\ 1 & 1 & 0 & 0\\ 1 & 1 & 0 & 0\end{pmatrix}$$

29. Write any properties of adjacency matrix.

1. An adjacency matrix completely defines a simple graph.
2. The adjacency matrix is symmetric.

30. Write the adjacency matrix of C_4.

Solution:

C_4 graph is

$$\begin{array}{c}\\ V_1\\ V_2\\ V_3\\ V_4\end{array}\begin{array}{c}\begin{array}{cccc}V_1 & V_2 & V_3 & V_4\end{array}\\ \begin{bmatrix}0 & 1 & 0 & 1\\ 1 & 0 & 1 & 0\\ 0 & 1 & 0 & 1\\ 1 & 0 & 1 & 0\end{bmatrix}\end{array}$$

31. Define Incidence matrix.

Let G be a graph with n vertices, Let $V=\{V_1,V_2,...V_n\}$ and $E=\{e_1,e_2,...e_m\}$ .Define $n\times m$ matrix.

$$I_G=\left[m_{ij}\right]_{n\times m} \quad \text{Where} \quad m_{ij}=\begin{cases}1 & \text{when } V_i \text{ is incident with } e_j\\ 0 & \text{Otherwise}\end{cases}$$

$$I_G=\begin{array}{c}\\ V_1\\ V_2\\ V_3\\ V_4\\ V_5\end{array}\begin{array}{c}\begin{array}{ccccc}e_1 & e_2 & e_3 & e_4 & e_5\end{array}\\ \begin{bmatrix}1 & 0 & 0 & 1 & 0\\ 1 & 1 & 0 & 0 & 0\\ 0 & 1 & 1 & 0 & 0\\ 0 & 0 & 1 & 1 & 1\\ 0 & 0 & 0 & 0 & 1\end{bmatrix}\end{array}$$

32. What is the sum of the entries in a row of the incidence matrix for an undirected graph?

Solution: Sum is 2 if e is not a loop, 1 if e is a loop.

33. Define Isomorphic Graphs.

Two graphs D and G' are isomorphic if there is a function

$f:V(G)\to V(G')$ from the vertices of G to the vertices of G' such that

(i) f is one-to-one

(ii) f is onto and

(iii) For each pair of vertices u and v of G

$$[u,v]\in E(G)\Leftrightarrow[f(u),f(v)]\in E(G')$$

Any function f with the above three properties is called an isomorphism from G to G'

34. Prove that any 2 simple connected graphs with n vertices all of degree 2 are isomorphic.

Solution: We know that total degree of a graph is given by

$$\sum_{i=1}^{n} d(V_i) = 2|E|$$

then $|V| = number\ of\ vertices\ n$ and $|E| = number$ of edges

Further the degree of every vertex is 2.

Therefore $\sum_{i=1}^{n} 2 = 2|E| \quad \Rightarrow 2((n)-1+1) = 2|E| \quad \Rightarrow n = |E|$

Number of edges=number of vertices. Therefore the graphs are cycle graphs Hence they are isomorphic.

35. Can a simple graph with 7 vertices be isomorphic to its complement?

Solution: A graph with 7 vertices can have a maximum number of edges.

$$= \frac{7(7-1)}{2} = \frac{7\times 6}{2} = 21 = 21 \quad \text{edges}$$

21 edges cannot be split into 2 equal integers. Therefore, G and $\overline{G}$ cannot equal number of edges. Hence a graph with 7 vertices cannot be isomorphic to its complement.

36. Define path.

A path in a multigraph G consists of an alternating sequence of vertices and edges of the form $V_0, e_1, V_1, e_2, V_2, ...e_{n-1}, V_{n-1}, e_n, V_n$ Where each edge e_i contains the length of the V_{i-1} and V_i

The number n of edges is called the length of the path.

37. Define circuit.

A path of length ≥ 1 with no repeated edges and whose end vertices are same is called a circuit.

38. Define path graph.

A path graph of order 'n' is obtained by removing on edge from a C_n graph, denoted by P_n.

39. Define trail.

A trail from v to w is a path from v to w that does not contain a repeated edge.

40. Define connected and disconnected graphs.

A graph G is a connected graph is there is atleast one path between every pair of vertices in G. otherwise G is a disconnected graph.

41. Define Euler circuit.

An Euler circuit in a graph G is a simple circuit containing every edge of G.

42. Define Euler path.

An Euler path in G is a simple path containing every degree of G.

43. Define Euler line and Euler graph.

A closed walk which contains all edges of the graph G is called an Euler line, and the graph containing atleast one Euler line is said to be an Euler graph.

44. Show that values of n is the graph K_n Eulerian?

Solution: We know that K_n ,the complete graph of n vertices is a connected graph in which degree of each vertices is n-1 .Because a graph is Eulerian if and only if it is connected and degree of each vertex is even, we conclude that K_n is an Euler graph if and only if n is odd.

45. Define Hamilton path.

A simple path in a graph G that passes through every vertex exactly once is called a Hamilton path. That is, the simple path $x_0, x_1, ..., x_{n-1}, x_n$ in the graph G=(V,E) is a Hamilton path if V= $\{x_0, x_1, ..., x_{n-1}, x\}$ and $x_i \neq x_j$ for $0 \leq i<j \leq n$.

46. Define Hamilton circuit.

A simple circuit in a graph G that passes through every vertex exactly once is called a Hamilton circuit. And the simple circuit $x_0, x_1, ..., x_{n-1}, x_n, x_0 (with$ n>0) is a Hamilton circuit if $x_0, x_1, ..., x_{n-1}, x_n$ is a Hamilton path.

47. Show that K_n has a Hamilton circuit whenever $n \geq 3$.

Solution: Now we can form a Hamilton circuit in K_n beginning at any vertex.

Such a circuit can be built by visiting vertices in any order we choose, as long as the path begins and ends at the same vertex and visits each other vertex exactly once

It is possible since there are edges in K_n between any two vertices.

48. State Dirac's theorem.

If G is a simple graph with r. vertices with $n \geq 3$ such that the degree of every vertex in G is at least n/2, then G has a Hamilton circuit.

49. State Ore's theorem.

If G is a simple graph with number of vertices n(≥ 3) and if

deg (u)+ deg(v)$\geq$n ……(1)

for every pair of non-adjacent vertices u and v ,then G is Hamiltonian.

50. Define Gray code.

A Gray code is a labeling of the arcs of the circles such that adjacent arcs are labeled with bit strings that differ in exactly one bit.

UNIT-IV - ALGEBRIC STRUCTURES

1. If S denotes the set of positive integers ≤ 100 for $x, y \in S$ define $x * y = min\{x, y\}$. Verify whether $(S,*)$ is a monoid assuming that $*$ is associative.

   Solution :

   100 is the identity element in (s,x).

   since 100*x = min {x,100}=x since x$\leq$ 100 for all $x \in S$.

   Therefore (s,x) is a monoid.

2. If H is a sub-group of a group G ,among the right coset of H in G ,Prove that there is only one subgroup H .

   Solution :

   Let Ha be a right coset of H and G where $a \in G$. If Ha is a subgroup of G, then

$e \in Ha$ where e is the identity element in G.

3. Give an example of subsemigroup.

   Solution :

   For the semi-group (N,+) , the set E of all even non negative integers is a sub semi

group (E,+) of (N,+).

4. Define Normal subgroup of a group.

   A subgroup H of a group G is called a normal sub group if for every $a \in G,\ aH = Ha$

5. Find all the cosets of the subgroup $H = \{1,-1\}$ in $G = \{1,-1,i,-i\}$ with the operation Multiplication.

   Solution :

   Let us find the right cosets of H in G.

$H(1) = \{1,-1\} = H$

$H(-1) = \{-1,1\} = H$

$H(i) = \{i,-i\}$ *and* $H(-i) = \{-i,i\} = Hi$

$H\square 1 = H = H\square -1 = \{1,-1\}$

and $Hi = H\square -i = \{i,-i\}$

are the two right cosets of H in G. Similarly we can find the left coset of H in G.

6. A semigroup homomorphism preserves property of associativity.

   Solution :

   Let $a \in S$ be an idempotent element.

   There fore a*a = a

$\Rightarrow g(a*a) = g(a)$

$g(a) \circ g(a) = g(a)$

This shows that $g(a)$ is an idempotent element in T.

There fore the property of idempotenct is preserved under semi group homomorphism.

7. A semigroup homomorphism preserves commutativity.
   Proof :

   Let $a, b \in S$

Assume that $a*b = b*a$

$g(a*b) = g(b*a)$

$g(a) \circ g(b) = g(b) \circ g(a)$

This means that the operation $\circ$ is commutative in T.

There fore the semi group homomorphism preserves commutativity.

8. Define abelian group and subgroup.
   Definition : Abelian group

   A group (G,*) is said to be abelian if a*b=b*a for all a,b$\in G$.

   Definition : Subgroup

   Let (G,*) be a group and let H be a non-empty subset of G. Then H is said to be a sub group of G if H itself is a group with the operation *.

9. Define ring and give an example of a ring with zero-divisors.
   Definition : An algebraic system $(S,+,*)$ is called a ring if the binary operations + and * on S satisfy the following 3 properties.

   i) (S,+) is an abelian group.

   ii) (S,*) is a semi group.

   iii) The operation * is distributive over + that is for any $a, b, c \in S$

$a.(b+c) = a.b + a.c$ and

$(b+c).a = b.a + c.a$

Example : The ring $(Z_{10}, +_{10}, \times_{10})$ not an integral domain. Since $5 \times_{10} 2 = 0,$ yet $5 \neq 0, 2 \neq 0$ in Z_{10}.

10. State Cayley's theorem on Permutation groups.
    Every finite group of order 'n' is isomorphic to a permutation group of degree n.

11. Prove that the only idempotent element of a group is its identity element.
    Idempotent element : An element $a \in G$ is said to be idempotent with respect

to * if a*a=a

Identity element : An element e of G is said to be identity element if

$e*a = a*e = a,$ for every $a \in G$

In a group the identity element e only satisfies the idempotent condition e*e=e.

12. What do you call a homomorphism of a semi group into itself?
Solution :

A homomorphism of a semi group into itself is called a semi group endomorphism.

13. Show that if every element in a group is its own inverse, then the group must be abelian.
Solution :

Let $(G,*)$ be a group.

Given : $a^{-1} = a, \forall a \in G$

To prove : a*b=b*a (Abelian)

Let $a,b \in G$

$\Rightarrow a^{-1} = a$ and $b^{-1} = b$

$a*b \in G$ $\quad [Since\ (G,*)\ \text{be a group}]$

$(a*b)^{-1} = a*b$ $\quad [Since\ \text{if every element in a group is its own inverse}]$

$b^{-1}*a^{-1} = a*b$ $\quad \left[Since (a*b)^{-1} = b^{-1}*a^{-1}\right]$

$b*a = a*b$ $\quad [by\ \ (1)]$

$Since\ (G,*)\text{is an abelian group.}$

14. Give an example of a Monoid which is not a group.

$(Z^+,*)$ is a monoid which is not a group. $\left[Since\ a \in G, \frac{1}{a} \notin G\right]$

15. Show that $(Z_5,+_5)$ is a cyclic group.

$+_5$	[0]	[1]	[2]	[3]	[4]
[0]	0	1	2	3	4
[1]	1	2	3	4	0
[2]	2	3	4	0	1
[3]	3	4	0	1	2
[4]	4	0	1	2	3

16. Define Semi group and monoid. Give an example of a semi group which is not a monoid
Definition : Semi group

Let S be a non empty set and $\circ$ be a binary operation on S. The algebraic system (S, $\circ$) is called a semigroup if the operation $\circ$ is associative. In other words (S, $\circ$) is semi group if for any x,y,z $\in G$, (x$\circ$y) $\circ$z = x$\circ$(y$\circ$z).

Definition : Monoid

An algebraic system (M, $\circ$) is a Monoid if

i) $\circ$ is binary

ii) $\circ$ is associative

iii) the set M has an identity with respect to the operation $\circ$.

Example : (Z, $\circ$) is a semi group.

The inverse property does not exist.

There fore (Z, $\circ$) is not a monoid.

17. A semigroup homomorphism preserves property of idempotency.
Let $f=(M,*)\to(H,\Delta)$ be semi group homomorphism.

x idempotent element in M.

Therefore $x*x=x,\ f(x*x)=f(x)\square f(x)$
Then $f(x)=f(x)\square f(x)$

Therefore idempotency is preserved.

18. Define a semigroup.
Solution:

If a non empty set S together with the binary operation '*' satisfying the following two properties:

a) a*b=b*a, $a,b\in S$ (Closure Property)

b) (a*b)*c=a*(b*c), $a,b,c\in S$ (Associative Property)

is called a semigroup. It is denoted by (S,*).

19. If 'a' is the generator of the cyclic group G, then show that a^{-1} is also a generator of G.
Solution:

Now $(a^{-1})=\left\{\left(a^{-1}\right)^{n};n\in z\right\}=\left\{a^{-n};n\in z\right\}=\left\{a^{m};m\in z\right\}=a$

UNIT-V - LATTICES AND BOOLEAN ALGBRA

1. **Is the lattice of divisors of 32 a Boolean algebra.**
   No. the divisors of 32 is a chain and hence it is not complemented.

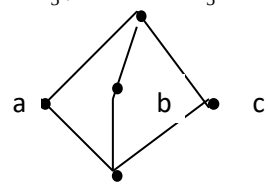
2. **Give an example of a lattice which is modular but not distributive**.

$M_5 \rightarrow$ Diamond lattice

In M_5, $a \vee (b \wedge c) = a \vee 0 = a$ while $(a \vee b) \wedge (a \vee c) = |\wedge| = 1$

So M_5 is not distributive.

As N_5 is not a sublattice of M_5, M_5 is modular.



3. **Obtain the Hasse diagram of $\langle \rho(A_3), \leq \rangle$ where $A_3 = \{x, y, z\}$.**
   Solution :

Given S={x,y,z}

P(S) = {{x},{y},{z},{x,y},{y,z},{z,x},{x,y,z},{}}

We know that {P(S), $\subseteq$} is a poset

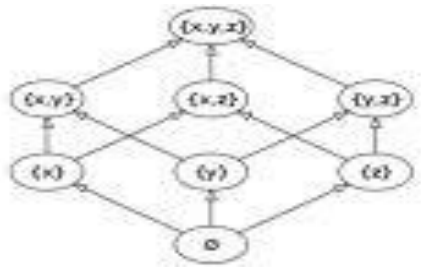
Since empty set is a subset of every set in P(S), { } is the least set of P(S).

Similarly S={x,y,z} contains all elements of P(S) ie an element of P(S) is a subset of {x,y,z}.

Therefore S is the greatest element in P(S).

Hence {P(S), $\subseteq$} is a lattice.

The Hasse diagram is



4. In a lattice (L, $\leq$), prove that $a \wedge (a \vee b) = a$, for all a,b $\in$ L.
   Solution:

Since $a \wedge b$ is the GLB of {a,b}, we have

$a \wedge b \leq a$ …….(1)

Obviously a $\leq$ a …..(2)

From (1) and (2), we have $a \vee (a \wedge b) \leq a$ ……(3)

By definition of LUB, we have $a \leq a \vee (a \wedge b)$ …..(4)

By combining (3) and (4), we have $a \vee (a \wedge b) = a$. Similarly we can prove $a \wedge (a \vee b) = a$.

5. Give an example of a relation which is symmetric but not reflexive.
6. Give an example of a relation which is reflexive but not symmetric.
7. Give an example of a relation which is both reflexive and symmetric.
8. Give an example of a relation which is neither reflexive nor symmetric.
9. Give an example of a relation which is both symmetric and anti-symmetric.
9. Give an example of a relation which is neither reflexive nor irreflexive.

10 Give an example of a relation which is neither symmetric nor anti-symmetric.

11 Let $X = \{1,2,3,4\}$ & $\boldsymbol{R = \{\langle 1,1\rangle, \langle 4,1\rangle, \langle 1,4\rangle, \langle 4,4\rangle, \langle 2,2\rangle, \langle 2,3\rangle, \langle 3,2\rangle, \langle 3,3\rangle\}}$.

Write the matrix of *R* and sketch its graph.

Show that $\boldsymbol{A \subseteq A \cup B}$ and $\boldsymbol{A \subseteq B \Leftrightarrow A \cup B = B}$ $\boldsymbol{A \cap B \subseteq A}$.

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CS8351-DIGITAL PRINCIPLES AND SYSTEM DESIGN

UNIT – I - MINIMIZATION TECHNIQUES AND LOGIC GATES

1) Define binary logic?

Binary logic consists of binary variables and logical operations. The variables are designated by the alphabets such as A, B, C, x, y, z, etc., with each variable having only two distinct values: 1 and 0. There are three basic logic operations: AND, OR, and NOT.

2) Convert (634) 8 to binary

6 3 4

110 011 100

Ans = 110011100

3) Convert (9B2 - 1A) H to its decimal equivalent.

$N = 9 \times 16^2 + B \times 16^1 + 2 \times 16^0 + 1 \times 16^{-1} + A\ (10) \times 16^{-2}$

= 2304 + 176 + 2 + 0.0625 + 0.039

= $\mathbf{2482.1_{10}}$

4) State the different classification of binary codes?

1. Weighted codes
2. Non - weighted codes
3. Reflective codes
4. Sequential codes
5. Alphanumeric codes
6. Error Detecting and correcting codes.

5) Convert 0.640625 decimal numbers to its octal equivalent.

0.640625 x 8 = 5.125

0.125 x 8 = 1.0

= 0.640 625 10 = **(0.51) 8**

6) Convert 0.1289062 decimal numbers to its hex equivalent

0.1289062 x 16 = 2.0625

0.0625 x 16 = 1.0

= $\mathbf{0.21_{16}}$

7) Convert 22.64 to hexadecimal number.

16 22 -6

16 1 -1

0

0.64 x 16 = 10.24

0.24 x 16 = 3.84

0.84 x 16 = 13.44

.44 x 16 = 7.04

Ans = (16. A 3 D 7) 16

8) State the steps involved in Gray to binary conversion?

The MSB of the binary number is the same as the MSB of the gray code number. So write it down. To obtain the next binary digit, perform an exclusive OR operation between the bit just written down and the next gray code bit. Write down the result.

9) Convert gray code 101011 into its binary equivalent.

Gray Code: 1 0 1 0 1 1

Binary Code: **1 1 0 0 1 0**

10) Substract (0 1 0 1) 2 from (1 0 1 1) 2

1 0 1 0

0 1 0 1

Answer = 0 1 1 0

11) Add (1 0 1 0) 2 and (0 0 1 1) 2

1 0 1 0

0 0 1 1

Answer = (1 1 0 1) 2

12) Using 10's complement subtract 72532 - 3250

M = 72532

10's complement of N = + 96750

---------- Sum = 169282

Discard end carry

Answer = 69282

13) Find 2'S complement of (1 0 1 0 0 0 1 1) 2

0 1 0 1 1 1 0 0 1 - 1's Complement

+ 1

0 1 0 1 1 1 0 1 0 - 2's complement.

14) Substract 1 1 1 0 0 1 2 from 1 0 1 0 1 1 2 using 2's complement method

1 0 1 0 1 1

+ 0 0 0 1 1 1 - 2's comp. of 1 1 1 0 0 1

1 1 0 0 1 0 in 2's complement form

Answer (0 0 1 1 1 0)2

15) Find the excess -3 code and 9's complement of the number 403_{10}

4 0 3

0 1 0 0 0 0 0 0 0 0 1 1

0 0 1 1 0 0 1 1 0 0 1 1 +

0 1 1 1 0 0 1 1 0 1 1 0 ----- excess 3 code

9's complement 1 0 0 0 1 1 0 0 1 0 0 1

16) What is meant by bit?

A binary digit is called bit

17) Define byte?

Group of 8 bits.

18) List the different number systems?

i) Decimal Number system ii) Binary
Number system iii) Octal Number system
iv) Hexadecimal Number system

19) State the abbreviations of ASCII and EBCDIC code?

ASCII-American Standard Code for Information Interchange. EBCDIC-
Extended Binary Coded Decimal Information Code.

20) What are the different types of number complements?

i) r's Complement

ii) (r-1)'s Complement.

21) Given the two binary numbers X = 1010100 and Y = 1000011, perform the subtraction

(a) X -Y and (b) Y - X using 2's complements. a) X =
1010100
2's complement of Y = 0111101

---------- Sum =
10010001
Discard end carry

***Answer:* X - Y = 0010001**

b) Y = 1000011

2's complement of X = + 0101100

---------- Sum =
1101111
There is no end carry, The MSB BIT IS 1.

Answer is Y-X = -(2's complement of 1101111) = - 0010001

22) Given the two binary numbers X = 1010100 and Y = 1000011, perform the subtraction

(a) X -Y and (b) Y - X using 1's complements. a) X - Y =
1010100 - 1000011
X = 1010100

1's complement of Y = + 0111100

---------- Sum =
10010000
End -around carry = + 1

***Answer:* X - Y = 0010001**

b) Y - X = 1000011 - 1010100

Y = 1000011

1's complement of X = + 0101011

---------- Sum = +
1101110
There is no end carry.
Therefore the answer is Y - X = -(1's complement of 1101110) = -0010001

23) Write the names of basic logical operators.

1. NOT / INVERT

2. AND

3. OR

24) What are basic properties of Boolean algebra?

The basic properties of Boolean algebra are commutative property, associative property and distributive property.

25) State the associative property of boolean algebra.

The associative property of Boolean algebra states that the OR ing of several variables results in the same regardless of the grouping of the variables. The associative property is stated as follows:

A+ (B+C) = (A+B) +C

26) State the commutative property of Boolean algebra.

The commutative property states that the order in which the variables are OR ed makes no difference. The commutative property is:

A+B=B+A

27) State the distributive property of Boolean algebra.

The distributive property states that AND ing several variables and OR ing the result with a single variable is equivalent to OR ing the single variable with each of the the several variables and then AND ing the sums. The distributive property is:

A+BC= (A+B) (A+C)

28) State the absorption law of Boolean algebra.

The absorption law of Boolean algebra is given by X+XY=X, X(X+Y) =X.

29) Simplify the following using De Morgan's theorem [((AB)'C)" D]' [((AB)'C)"

D]' = ((AB)'C)" + D' [(AB)' = A' + B']

= (AB)' C + D'

= (A' + B')C + D'

30) State De Morgan's theorem.

De Morgan suggested two theorems that form important part of Boolean algebra.

They are,

1) The complement of a product is equal to the sum of the complements. (AB)' = A' + B'

2) The complement of a sum term is equal to the product of the complements. (A + B)' = A'B'

31) Reduce A.A'C

A.A'C = 0.C [A.A' = 1]

= 0

31) Reduce A(A + B)

A(A + B) = AA + AB

= A(1 + B) [1 + B = 1]

= A.

32) Reduce A'B'C' + A'BC' + A'BC

A'B'C' + A'BC' + A'BC = A'C'(B' + B) + A'B'C

= A'C' + A'BC [A + A' = 1]

= A'(C' + BC)

= A'(C' + B) [A + A'B = A + B]

33) Reduce AB + (AC)' + AB'C(AB + C)

AB + (AC)' + AB'C(AB + C) = AB + (AC)' + AAB'BC + AB'CC

= AB + (AC)' + AB'CC [A.A' = 0]

= AB + (AC)' + AB'C [A.A = 1]

= AB + A' + C' =AB'C [(AB)' = A' + B']

= A' + B + C' + AB'C [A + AB' = A + B]

= A' + B'C + B + C' [A + A'B = A + B]

= A' + B + C' + B'C

=A' + B + C' + B'

=A' + C' + 1

= 1 [A + 1 =1]

34) Simplify the following expression Y = (A + B)(A + C')(B' + C') Y = (A + B)(A + C')(B' + C')
= (AA' + AC +A'B +BC)(B' + C') [A.A' = 0]

= (AC + A'B + BC)(B' + C')

= AB'C + ACC' + A'BB' + A'BC' + BB'C + BCC'

= AB'C + A'BC'

35) Show that (X + Y' + XY)(X + Y')(X'Y) = 0

(X + Y' + XY)(X + Y')(X'Y) = (X + Y' + X)(X + Y')(X' + Y) [A + A'B = A + B]

= (X + Y')(X + Y')(X'Y) [A + A = 1]

= (X + Y')(X'Y) [A.A = 1]

= X.X' + Y'.X'.Y

= 0 [A.A' = 0]

36) Prove that ABC + ABC' + AB'C + A'BC = AB + AC + BC

ABC + ABC' + AB'C + A'BC=AB(C + C') + AB'C + A'BC

=AB + AB'C + A'BC

=A(B + B'C) + A'BC

=A(B + C) + A'BC

=AB + AC + A'BC

=B(A + C) + AC

=AB + BC + AC

=AB + AC +BC ...Proved

37) Convert the given expression in canonical SOP form Y = AC + AB + BC Y = AC + AB + BC

=AC(B + B') + AB(C + C') + (A + A')BC

=ABC + ABC' + AB'C + AB'C' + ABC + ABC' + ABC

=ABC + ABC' +AB'C + AB'C' [A + A =1]

38) Define duality property.

Duality property states that every algebraic expression deducible from the postulates of Boolean algebra remains valid if the operators and identity elements are interchanged. If the dual of an algebraic expression is desired, we simply interchange OR and AND operators and replace 1's by 0's and 0's by 1's.

39) Find the complement of the functions F1 = x'yz' + x'y'z and F2 = x(y'z' + yz). By applying De-Morgan's theorem.

F1' = (x'yz' + x'y'z)' = (x'yz')'(x'y'z)' = (x + y' + z)(x + y +z') F2' = [x(y'z' + yz)]' = x' + (y'z' + yz)'

= x' + (y'z')'(yz)'

= x' + (y + z)(y' + z')

40) Simplify the following expression

Y = (A + B) (A = C) (B + C)

= (A A + A C + A B + B C) (B + C)

= (A C + A B + B C) (B + C)

= A B C + A C C + A B B + A B C + B B C + B C C

= A B C

41) What are the methods adopted to reduce Boolean function?

i) Karnaug map

ii) Tabular method or Quine Mc-Cluskey method iii) Variable entered map technique.

42) State the limitations of karnaugh map.

i) Generally it is limited to six variable map (i.e) more then six variable involving expression are not reduced.

ii) The map method is restricted in its capability since they are useful for simplifying only Boolean expression represented in standard form.

43) What is a karnaugh map?

A karnaugh map or k map is a pictorial form of truth table, in which the map diagram is made up of squares, with each squares representing one minterm of the function.

44) Find the minterms of the logical expression Y = A'B'C' + A'B'C + A'BC + ABC' Y = A'B'C' + A'B'C + A'BC + ABC'

=m0 + m1 +m3 +m6

=_m(0, 1, 3, 6)

45) Write the maxterms corresponding to the logical expression

Y = (A + B + C')(A + B' + C')(A' + B' + C)

= (A + B + C')(A + B' + C')(A' + B' + C)

=M1.M3.M6

=_ M(1,3,6)

46) What are called don’t care conditions?

In some logic circuits certain input conditions never occur, therefore the corresponding output never

appears. In such cases the output level is not defined, it can be either high or low. These output levels are indicated by ‘X’ or‘d’ in the truth tables and are called don’t care conditions or incompletely specified functions.

47) What is a prime implicant?

A prime implicant is a product term obtained by combining the maximum possible number of adjacent squares in the map.

48) What is an essential implicant?

If a min term is covered by only one prime implicant, the prime implicant is said to be essential

UNIT – II - COMBINATIONAL CIRCUITS

1) What is a Logic gate?

Logic gates are the basic elements that make up a digital system. The electronic gate is a circuit that is able to operate on a number of binary inputs in order to perform a particular logical function.

2) Give the classification of logic families

logic families

. Bipolar

1. Saturated
1.1 RTL
1.2 ECL
1.3 I I C
1.4 TTL

2. Non Saturated
2.1.Schottky TTL
2.2. DTL

2.Unipolar

1. PMOS
2. NMOS
3.
3. CMOS

3) What are the basic digital logic gates?

The three basic logic gates are

1. AND gate
2. OR gate
3. NOT gate

4) Which gates are called as the universal gates? What are its advantages?

The NAND and NOR gates are called as the universal gates. These gates are used to perform any type of logic application.

5) Classify the logic family by operation?

The Bipolar logic family is classified into

1. Saturated logic
2. Unsaturated logic.

The RTL, DTL, TTL, I2L, HTL logic comes under the saturated logic family. The Schottky TTL, and ECL logic comes under the unsaturated logic family.

6) State the classifications of FET devices.

FET is classified as

1. Junction Field Effect Transistor (JFET)
2. Metal oxide semiconductor family (MOS).

7) Mention the classification of saturated bipolar logic families.

The bipolar logic family is classified as follows:

1. RTL- Resistor Transistor Logic
2. DTL- Diode Transistor logic
3. I2L- Integrated Injection Logic
4. TTL- Transistor Transistor Logic
5. ECL- Emitter Coupled Logic

8) Mention the different IC packages?

1. DIP- Dual in line package
2. LCC- Leadless Chip Carrier
3. PLCC- Plastic Leaded Chip carrier
4. PQFP- Plastic Quad Flat Pack
5. PGA- Pin Grid Array

9) Mention the important characteristics of digital IC's?

1. Fan out
2. Power dissipation
3. Propagation Delay
4. Noise Margin
5. Fan In
6. Operating temperature
7. Power supply requirements

10) Define Fan-out?

Fan out specifies the number of standard loads that the output of the gate can drive with out impairment of its normal operation.

11) Define Power dissipation.

Power dissipation is measure of power consumed by the gate when fully driven by all its inputs.

12) What is propagation delay?

Propagation delay is the average transition delay time for the signal to propagate from input to output when the signals change in value. It is expressed in ns.

13) Define noise margin?

It is the maximum noise voltage added to an input signal of a digital circuit that does not cause an undesirable change in the circuit output. It is expressed in volts.

14) Define fan in?

Fan in is the number of inputs connected to the gate without any degradation in the voltage level.

15) What is Operating temperature?

All the gates or semiconductor devices are temperature sensitive in nature. The temperature in which the performance of the IC is effective is called as operating temperature. Operating temperature of the IC vary from 00 C to 700 c.

16) What is High Threshold Logic?

Some digital circuits operate in environments, which produce very high noise signals. For operation in such surroundings there is available a type of DTL gate which possesses a high threshold to noise immunity. This type of gate is called HTL logic or High Threshold Logic.

17) What are the types of TTL logic?

1. Open collector output
2. Totem-Pole Output
3. Tri-state output.

18) What is depletion mode operation MOS?

If the channel is initially doped lightly with p-type impurity a conducting channel exists at zero gate voltage and the device is said to operate in depletion mode.

19) What is enhancement mode operation of MOS?

If the region beneath the gate is left initially uncharged the gate field must induce a channel before current can flow. Thus the gate voltage enhances the channel current and such a device is said to operate in the enhancement mode.

20) Mention the characteristics of MOS transistor?

1. The n- channel MOS conducts when its gate- to- source voltage is positive.
2. The p- channel MOS conducts when its gate- to- source voltage is negative
3. Either type of device is turned of if its gate- to- source voltage is zero.

21) How schottky transistors are formed and state its use?

A schottky diode is formed by the combination of metal and semiconductor. The presence of schottky diode between the base and the collector prevents the transistor from going into saturation. The resulting transistor is called as schottky transistor. The use of schottky transistor in TTL decreases the propagation delay without a sacrifice of power dissipation.

22) List the different versions of TTL

1.TTL (Std.TTL) 2.LTTL (Low Power TTL)

3.HTTL (High Speed TTL) 4.STTL (Schottky TTL)

5.LSTTL (Low power Schottky TTL)

23) Why totem pole outputs cannot be connected together.

Totem pole outputs cannot be connected together because such a connection might produce excessive current and may result in damage to the devices.

24) State advantages and disadvantages of TTL

Adv:

Easily compatible with other ICs

Low output impedance

Disadv:

Wired output capability is possible only with tristate and open collector types Special circuits in Circuit layout and system design are required.

25) When does the noise margin allow digital circuits to function properly.

When noise voltages are within the limits of VNA(High State Noise Margin) and VNK

for a particular logic family.

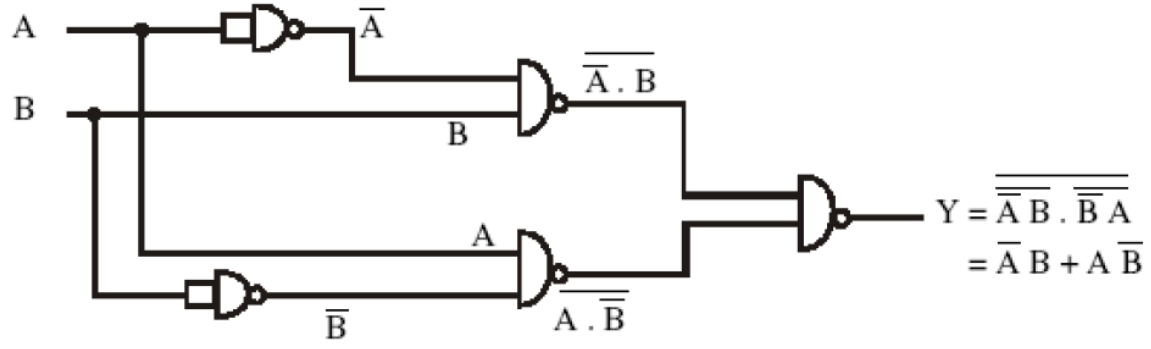
26) What happens to output when a tristate circuit is selected for high impedance.

Output is disconnected from rest of the circuits by internal circuitry.

27) What is 14000 series.

It is the oldest and standard CMOS family. The devices are not pin compatible or electrically compatible with any TTL Series.

28) Implement the Boolean Expression for EX – OR gate using NAND Gates.



29) Define combinational logic

When logic gates are connected together to produce a specified output for certain specified combinations of input variables, with no storage involved, the resulting circuit is called combinational logic.

30) 78. Explain the design procedure for combinational circuits

1. The problem definition
2. Determine the number of available input variables & required O/P variables.
3. Assigning letter symbols to I/O variables
4. Obtain simplified Boolean expression for each O/P.
5. Obtain the logic diagram.

31) Define Half adder and full adder

The logic circuit that performs the addition of two bits is a half adder. The circuit that performs the addition of three bits is a full adder.

32) Draw the logic Symbol and construct the truth table for the two input EX – OR gate.

Logic Symbol

Truth Table

Inputs		Output
A	B	Y
0	0	0
0	1	1
1	0	1
1	1	0

33) Define Decoder

A decoder is a multiple - input multiple output logic circuit that converts coded inputs into coded outputs where the input and output codes are different.

34) What is binary decoder?

A decoder is a combinational circuit that converts binary information from n input lines to a maximum of 2n out puts lines.

35) Define Encoder

An encoder has 2n input lines and n output lines. In encoder the output lines generate the binary code corresponding to the input value.

36) What is priority Encoder?

A priority encoder is an encoder circuit that includes the priority function. In priority encoder, if 2

or more inputs are equal to 1 at the same time, the input having the highest priority will take precedence.

37) Define multiplexer

Multiplexer is a digital switch. If allows digital information from several sources to be routed onto a single output line.

38) What do you mean by comparator?

A comparator is a special combinational circuit designed primarily to compare the relative magnitude of two binary numbers.

39) List basic types of programmable logic devices.

1. Read only memory
2. Programmable logic Array
3. Programmable Array Logic

40) Define ROM

Read only memory is a device that includes both the decoder and the OR gates within a single IC package.

41) Define address and word:

In a ROM, each bit combination of the input variable is called on address. Each bit combination that comes out of the output lines is called a word.

42) State the types of ROM

1. Masked ROM.
2. Programmable Read only Memory
3. Erasable Programmable Read only memory.
4. Electrically Erasable Programmable Read only Memory.

43) What is programmable logic array? How it differs from ROM?

In some cases the number of don't care conditions is excessive, it is more economical to use a second type of LSI component called a PLA. A PLA is similar to a ROM in concept; however it does not provide full decoding of the variables and does not generates all the minterms as in the ROM.

44) Which gate is equal to AND-invert Gate?

NAND gate.

45) Which gate is equal to OR-invert Gate?

NOR gate.

46) Bubbled OR gate is equal to---------- - NAND gate

47) Bubbled AND gate is equal to---------- - NOR

gate

UNIT –III - SEQUENTIAL CIRCUITS

1) What are the classifications of sequential circuits?

The sequential circuits are classified on the basis of timing of their signals into two types. They are,

1)Synchronous sequential circuit.

2)Asynchronous sequential circuit.

2) Define Flip flop.

The basic unit for storage is flip flop. A flip-flop maintains its output state either at 1 or 0 until directed by an input signal to change its state.

3) What are the different types of flip-flop?

There are various types of flip flops. Some of them are mentioned below they are, RS flip-flop, SR flip-flop D flip-flop JK flip-flop T flip-flop

4) What is the operation of RS flip-flop?

- When R input is low and S input is high the Q output of flip-flop is set.
- When R input is high and S input is low the Q output of flip-flop is reset.
- When both the inputs R and S are low the output does not change
- When both the inputs R and S are high the output is unpredictable.

5) What is the operation of SR flip-flop?

- When R input is low and S input is high the Q output of flip-flop is set.
- When R input is high and S input is low the Q output of flip-flop is reset.
- When both the inputs R and S are low the output does not change.
- When both the inputs R and S are high the output is unpredictable.

6) What is the operation of D flip-flop?

In D flip-flop during the occurrence of clock pulse if D=1, the output Q is set and if D=0, the output is reset.

7) What is the operation of JK flip-flop?

- When K input is low and J input is high the Q output of flip-flop is set.
- When K input is high and J input is low the Q output of flip-flop is reset.
- When both the inputs K and J are low the output does not change
- When both the inputs K and J are high it is possible to set or reset the flip-flop

(ie) the output toggle on the next positive clock edge.

8) What is the operation of T flip-flop?

T flip-flop is also known as Toggle flip-flop.

- When T=0 there is no change in the output.
- When T=1 the output switch to the complement state (ie) the output toggles.

9) Define race around condition.

In JK flip-flop output is fed back to the input. Therefore change in the output results change in the input. Due to this in the positive half of the clock pulse if both J and K are high then output toggles continuously. This condition is called 'race around condition'.

10) What is edge-triggered flip-flop?

The problem of race around condition can solved by edge triggering flip flop. The term edge triggering means that the flip-flop changes state either at the positive edge or negative edge of the clock pulse and it is sensitive to its inputs only at this transition of the clock.

11) What is a master-slave flip-flop?

A master-slave flip-flop consists of two flip-flops where one circuit serves as a master and the other as a slave.

12) Define rise time.

The time required to change the voltage level from 10% to 90% is known as rise time(tr).

13) Define fall time.

The time required to change the voltage level from 90% to 10% is known as fall time(tf).

14) Define skew and clock skew.

The phase shift between the rectangular clock waveforms is referred to as skew and the time delay between the two clock pulses is called clock skew.

15) Define setup time.

The setup time is the minimum time required to maintain a constant voltage levels at the excitation inputs of the flip-flop device prior to the triggering edge of the clock pulse in order for the levels to be reliably clocked into the flip flop. It is denoted as t_{setup} .

16) Define hold time.

The hold time is the minimum time for which the voltage levels at the excitation inputs must remain constant after the triggering edge of the clock pulse in order for the levels to be reliably clocked into the flip flop. It is denoted as t_{hold}.

17) Define propagation delay.

A propagation delay is the time required to change the output after the application of the input.

18) Define registers.

A register is a group of flip-flops flip-flop can store one bit information. So an n-bit register has a group of n flip-flops and is capable of storing any binary information/number containing n-bits.

19) Define shift registers.

The binary information in a register can be moved from stage to stage within the register or into or out of the register upon application of clock pulses. This type of bit movement or shifting is essential for certain arithmetic and logic operations used in microprocessors. This gives rise to group of registers called shift registers.

20) What are the different types of shift type?

There are five types. They are,

Serial In Serial Out Shift Register

Serial In Parallel Out Shift Register

Parallel In Serial Out Shift Register

Parallel In Parallel Out Shift Register

Bidirectional Shift Register

21) Explain the flip-flop excitation tables for RS FF.

RS flip-flop

In RS flip-flop there are four possible transitions from the present state to the next state. They are,

0 1transition: This can happen either when R=S=0 or when R=1 and S=0.

0 1 transition: This can happen only when S=1 and R=0.

1 0 transition: This can happen only when S=0 and R=1.

2 1 transition: This can happen either when S=1 and R=0 or S=0 and R=0.

22) Explain the flip-flop excitation tables for JK flip-flop

In JK flip-flop also there are four possible transitions from present state to next state. They are,

0 1 transition: This can happen when J=0 and K=1 or K=0.

0 1 transition: This can happen either when J=1 and K=0 or when J=K=1.

1 0 transition: This can happen either when J=0 and K=1 or when J=K=1.

2 1 transition: This can happen when K=0 and J=0 or J=1.

23) Explain the flip-flop excitation tables for D flip-flop

In D flip-flop the next state is always equal to the D input and it is independent of the present state. Therefore D must be 0 if Q_{n+1} has to 0,and if Q_{n+1} has to be 1 regardless the value of Q_n.

24) Explain the flip-flop excitation tables for T flip-flop

When input T=1 the state of the flip-flop is complemented; when T=0,the state of the flip-flop remains unchanged. Therefore, for 0 and 1 1 transitions T must be 0 and or 0 1 and 0 transitions must be 1.

25) Define sequential circuit?

In sequential circuits the output variables dependent not only on the present input variables but they also depend up on the past history of these input variables.

26) Give the comparison between combinational circuits and sequential circuits.

Combinational circuits	Sequential circuits
1. Memory unit is not required	1. Memory unity is required
2. Parallel adder is a combinational circuit	2. Serial adder is a sequential circuit

27) What do you mean by present state?

The information stored in the memory elements at any given time define.s the present state of the sequential circuit.

28) What do you mean by next state?

The present state and the external inputs determine the outputs and the next state of the sequential circuit.

29) State the types of sequential circuits?

1. Synchronous sequential circuits
2. Asynchronous sequential circuits

30) Define synchronous sequential circuit

In synchronous sequential circuits, signals can affect the memory elements only at discrete instant of time.

31) Define Asynchronous sequential circuit?

In asynchronous sequential circuits change in input signals can affect memory element at any instant of time.

32) Give the comparison between synchronous & Asynchronous sequential circuits?

Synchronous sequential circuits	Asynchronous sequential circuits.

1.Memory elements are clocked flip-flops	1.Memory elements are either unlocked flip - flops or time delay elements.
2. Easier to design	2. More difficult to design

33) Define flip-flop

Flip - flop is a sequential device that normally samples its inputs and changes its outputs only at times determined by clocking signal.

34) What is race around condition?

In the JK latch, the output is feedback to the input, and therefore changes in the output results change in the input. Due to this in the positive half of the clock pulse if J and K are both high then output toggles continuously. This condition is known as race around condition.

35) What are the types of shift register?

1. Serial in serial out shift register?
2. Serial in parallel out shift register
3. Parallel in serial out shift register
4. Parallel in parallel out shift register
5. Bidirectional shift register shift register

36) State the types of counter?

1. Synchronous counter
2. Asynchronous Counter

37) Give the comparison between synchronous & Asynchronous counters.

In this type of counter flip-flops are connected in such a way that output of 1st flip-flop drives the clock for the next flip- flop.	In this type there is no connection between output of first flip-flop and clock input of the next flip - flop
All the flip-flops are Not clocked simultaneously	All the flip-flops are clocked simultaneously

UNIT-IV - MEMORY DEVICES

1) Explain ROM

A read only memory(ROM) is a device that includes both the decoder and the OR gates within a single IC package. It consists of n input lines and m output lines. Each bit combination of the input variables is called an address. Each bit combination that comes out of the output lines is called a word. The number of distinct addresses possible with n input variables is 2_n

2) What are the types of ROM?

1.PROM

2.EPROM

3.EEPROM

3) Explain PROM.

PROM (Programmable Read Only Memory) It allows user to store data or program. PROMs use the fuses with material like nichrome and polycrystalline. The user can blow these fuses by passing around 20 to 50 mA of current for the period 5 to 20µ s.The blowing of fuses is called programming of ROM. The PROMs are one time programmable. Once programmed, the information is stored permanent.

4) Explain EPROM.

EPROM(Erasable Programmable Read Only Memory)

EPROM use MOS circuitry. They store 1's and 0's as a packet of charge in a buried layer of the IC chip. We can erase the stored data in the EPROMs by exposing the chip to ultraviolet light via its quartz window for 15 to 20 minutes. It is not possible to erase selective information. The chip can be reprogrammed.

5) Explain EEPROM.

EEPROM(Electrically Erasable Programmable Read Only Memory)

EEPROM also use MOS circuitry. Data is stored as charge or no charge on an insulated layer or an insulated floating gate in the device. EEPROM allows selective erasing at the register level rather than erasing all the information since the information can be changed by using electrical signals.

6) What is RAM?
Random Access Memory. Read and write operations can be carried out.

7) Define ROM
A read only memory is a device that includes both the decoder and the OR gates within a single IC package.

8) Define address and word:
In a ROM, each bit combination of the input variable is called on address. Each bit combination that comes out of the output lines is called a word.

9) What are the types of ROM.

1. Masked ROM.

2. Programmable Read only Memory

3. Erasable Programmable Read only memory.

4. Electrically Erasable Programmable Read only Memory.

10) What is programmable logic array? How it differs from ROM?

In some cases the number of don't care conditions is excessive, it is more economical to use a second type of LSI component called a PLA. A PLA is similar to a ROM in concept; however it does not provide full decoding of the variables and does not generates all the minterms as in the ROM.

11) What is mask - programmable?

With a mask programmable PLA, the user must submit a PLA program table to the manufacturer.

12) What is field programmable logic array?

The second type of PLA is called a field programmable logic array. The user by means of certain recommended procedures can program the EPLA.

13) List the major differences between PLA and PAL PLA:

1. Both AND and OR arrays are programmable and Complex

   Costlier than PAL PAL

2. AND arrays are programmable OR arrays are fixed

   Cheaper and Simpler

14) Define PLD.

Programmable Logic Devices consist of a large array of AND gates and OR gates that can be programmed to achieve specific logic functions.

15) Give the classification of PLDs.

PLDs are classified as PROM (Programmable Read Only Memory), Programmable

Logic Array(PLA), Programmable Array Logic (PAL), and Generic Array Logic(GAL)

16) Define PROM.

PROM is Programmable Read Only Memory. It consists of a set of fixed AND gates connected to a decoder and a programmable OR array.

17) Define PLA

PLA is Programmable Logic Array(PLA). The PLA is a PLD that consists of a programmable AND array and a programmable OR array.

18) Define PAL

PAL is Programmable Array Logic. PAL consists of a programmable AND array and a fixed OR array with output logic.

19) Why was PAL developed?

It is a PLD that was developed to overcome certain disadvantages of PLA, such as longer delays due to additional fusible links that result from using two programmable arrays and more circuit complexity.

20) Define GAL.

GAL is Generic Array Logic. GAL consists of a programmable AND array and a fixed OR array with output logic.

21) Why the input variables to a PAL are buffered?

The input variables to a PAL are buffered to prevent loading by the large number of AND

gate inputs to which available or its complement can be connected.

22) What does PAL 10L8 specify?

PAL - Programmable Logic Array

10 - Ten inputs

L - Active LOW Ouput

8 - Eight Outputs

23) What is CPLD?

CPLDs are Complex Programmable Logic Devices. They are larger versions of PLDs with a centralized internal interconnect matrix used to connect the device macro cells together.

24) Define bit, byte and word.

The smallest unit of binary data is bit. Data are handled in a 8 bit unit called byte. A

complete unit of information is called a word which consists of one or more bytes.

25) How many words can a 16x8 memory can store?

A 16x8 memory can store 16,384 words of eight bits each

26) Define address of a memory.

The location of a unit of data in a memory is called address.

27) Define Capacity of a memory.

It is the total number of data units that can be stored.

28) What is Read and Write operation?

The Write operation stores data into a specified address into the memory and the Read operation takes data out of a specified address in the memory.

29) Why RAMs are called as Volatile?

RAMs are called as Volatile memories because RAMs lose stored data when the power is turned OFF.

30) Define ROM.

ROM is a type of memory in which data are stored permanently or semi permanently. Data can be read from a ROM, but there is no write operation

31) Define RAM.

RAM is Random Access Memory. It is a random access read/write memory. The data can be read or written into from any selected address in any sequence.

32) List the two categories of RAMs.

The two categories of RAMs are static RAM (SRAM) and dynamic RAM (DRAM).

33) Define Static RAM and dynamic RAM.

Static RAM uses flip flops as storage elements and therefore store data indefinitely as long as dc power is applied. Dynamic RAMs use capacitors as storage elements and cannot retain data very long without capacitors being recharged by a process called refreshing.

34) List the two types of SRAM.

1. Asynchronous SRAMs
2. Synchronous Burst SRAMs

35) List the basic types of DRAMs

Fast Page Mode DRAM, Extended Data Out DRAM (EDO DRAM), Burst EDO DRAM and Synchronous DRAM.

36) Define a bus.

A bus is a set of conductive paths that serve to interconnect two or more functional components of a system or several diverse systems.

37) Define Cache memory

It is a relatively small, high-speed memory that can store the most recently used instructions or data from larger but slower main memory.

38) What is the technique adopted by DRAMs.

DRAMs use a technique called address multiplexing to reduce the number of address

lines.

39) Give the feature of UV EPROM

UV EPROM is electrically programmable by the user, but the store data must be erased by exposure to ultra violet light over a period of several minutes.

40) Give the feature of flash memory.

The ideal memory has high storage capacity, non-volatility; in-system read and write capability, comparatively fast operation. The traditional memory technologies such as ROM, PROM, EEPROM individually exhibits one of these characteristics, but no single technology has all of them except the flash memory.

41) What are Flash memories?

They are high density read/write memories that are non-volatile, which means data can be stored indefinitely without power.

42) List the three major operations in a flash memory.

Programming, Read and Erase operation

43) What is a FIFO memory?

The term FIFO refers to the basic operation of this type of memory in which the first data bit written into the memory is to first to be read out.

44) List basic types of programmable logic devices.

1. Read only memory
2. Programmable logic Array
3. Programmable Array Logic

45) Define ROM.

A read only memory is a device that includes both the decoder and the OR gates within a single IC package.

46) Define address and word:

In a ROM, each bit combination of the input variable is called on address. Each bit combination that comes out of the output lines is called a word.

47) What are the types of ROM?

1. Masked ROM.
2. Programmable Read only Memory
3. Erasable Programmable Read only memory.
4. Electrically Erasable Programmable Read only Memory.

48) What is programmable logic array? How it differs from ROM?

In some cases the number of don't care conditions is excessive, it is more economical to use a second type of LSI component called a PLA. A PLA is similar to a ROM in concept; however it does not provide full decoding of the variables and does not generates all the min-terms as in the ROM.

49) What is mask - programmable?

With a mask programmable PLA, the user must submit a PLA PLA program table to the manufacturer.

50) Give the comparison between PROM and PLA.

PROM	PLA
And array is fixed and OR array is programmable.	Both AND and OR arrays are Programmable.
Cheaper and simple to use.	Costliest and complex than PROMS.

UNIT-V - SYNCHRONOUS AND ASYNCHRONOUS SEQUENTIAL CIRCUITS

1) What are secondary variables?

    -present state variables in asynchronous sequential circuits

2) What are excitation variables?

    -next state variables in asynchronous sequential circuits

3) What is fundamental mode sequential circuit?

    a. -input variables changes if the circuit is stable

    b. -inputs are levels, not pulses

    c. -only one input can change at a given time

4) What are pulse mode circuits?

    a. -inputs are pulses

    b. -width of pulses are long for circuit to respond to the input

    c. -pulse width must not be so long that it is still present after the new state is reached

5) What is the significance of state assignment?

    a. In synchronous circuits-state assignments are made with the objective of circuit reduction
    b. Asynchronous circuits-its objective is to avoid critical races

6) When do race conditions occur?
    -Two or more binary state variables change their value in response to the change in i/p variable

7) What is non critical race?
    -final stable state does not depend on the order in which the state variable changes
    -race condition is not harmful

8) What is critical race?

    a. -final stable state depends on the order in which the state variable changes

    b. -race condition is harmful

9) When does a cycle occur?
    -asynchronous circuit makes a transition through a series of unstable state

10) What are the different techniques used in state assignment?

    a. -shared row state assignment

    b. -one hot state assignment

11) What are the steps for the design of asynchronous sequential circuit?

a. -construction of primitive flow table

b. -reduction of flow table

c. -state assignment is made

d. -realization of primitive flow table

12) What is hazard?

-unwanted switching transients

13) What is static 1 hazard?

-output goes momentarily 0 when it should remain at 1

14) What is static 0 hazard?

-output goes momentarily 1 when it should remain at 0

15) What is dynamic hazard?

-output changes 3 or more times when it changes from 1 to 0 or 0 to 1

16) What is the cause for essential hazards?

-unequal delays along 2 or more path from same input

17) What is flow table?

-state table of an synchronous sequential network

18) What is SM chart?

a. -describes the behavior of a state machine

b. -used in hardware design of digital systems

19) What are the advantages of SM chart?

a. -easy to understand the operation

b. -east to convert to several equivalent forms

20) What is primitive flow chart?

-One stable state per row

21) What is combinational circuit?

Output depends on the given input. It has no storage element.

22) What is state equivalence theorem?

Two states SA and SB, are equivalent if and only if for every possible input X sequence, the outputs are the same and the next states are equivalent

i. i.e., if SA (t + 1) = SB (t + 1) and ZA = ZB then SA = SB.

23) What do you mean by distinguishing sequences?

Two states, SA and SB of sequential machine are distinguishable if and only if their exists at least one finite input sequence. Which, when applied to sequential machine causes different output sequences depending on whether SA or SB is the initial state.

24) Prove that the equivalence partition is unique

Consider that there are two equivalence partitions exists : PA and PB, and PA) PB. This states that, there exist 2 states Si & Sj which are in the same block of one partition and not in the same block of the other. If Si & Sj are in different blocks of say PB, there exists at least on input sequence which distinguishes Si & Sj and therefore, they cannot be in the same block of PA.

25) Define compatibility.

States Si and Sj said to be compatible states, if and only if for every input sequence that affects the two states, the same output sequence, occurs whenever both outputs are specified and regardless of whether Si on Sj is the initial state.

26) Define merger graph.

The merger graph is defined as follows. It contains the same number of vertices as the state table contains states. A line drawn between the two state vertices indicates each compatible state pair. It two states are incompatible no connecting line is drawn.

27) Define incompatibility.

The states are said to be incompatible if no line is drawn in between them. If implied states are incompatible, they are crossed & the corresponding line is ignored.

28) Explain the procedure for state minimization.

a. Partition the states into subsets such that all states in the same subsets are 1 - equivalent.
b. Partition the states into subsets such that all states in the same subsets are 2 - equivalent.
c. Partition the states into subsets such that all states in the same subsets are 3 - equivalent.

29) Define closed covering.

A Set of compatibles is said to be closed if, for every compatible contained in the set, all its implied compatibles are also contained in the set. A closed set of compatibles, which contains all the states of M, is called a closed covering.

30) Define machine equivalence.

Two machines, M1 and M2 are said to be equivalent if and only if, for every state in

M1, there is a corresponding equivalent state in M2 & vice versa.

31) Define state table.

For the design of sequential counters we have to relate present states and next states. The table, which represents the relationship between present states and next states, is called state table.

32) Define total state

The combination of level signals that appear at the inputs and the outputs of the delays define what is called the total state of the circuit.

33) What are the steps for the design of asynchronous sequential circuit?

1. Construction of a primitive flow table from the problem statement.

2. Primitive flow table is reduced by eliminating redundant states using the state reduction
3. State assignment is made

4. The primitive flow table is realized using appropriate logic elements.

34) Define primitive flow table :

It is defined as a flow table which has exactly one stable state for each row in the table. The design process begins with the construction of primitive flow table.

35) What are the types of asynchronous circuits?

1. Fundamental mode circuits

2. Pulse mode circuits

36) Give the comparison between state Assignment Synchronous circuit and state assignment asynchronous circuit.

In synchronous circuit, the state assignments are made with the objective of circuit reduction. In asynchronous circuits, the objective of state assignment is to avoid critical races.

37) What are races?

When 2 or more binary state variables change their value in response to a change in an input variable, race condition occurs in an asynchronous sequential circuit. In case of unequal delays, a race condition may cause the state variables to change in an unpredictable manner.

38) Define non critical race.

If the final stable state that the circuit reaches does not depend on the order in which the state variable changes, the race condition is not harmful and it is called a non critical race.

39) Define critical race.

If the final stable state depends on the order in which the state variable changes, the race condition is harmful and it is called a critical race.

40) What is a cycle?

A cycle occurs when an asynchronous circuit makes a transition through a series of unstable states. If a cycle does not contain a stable state, the circuit will go from one unstable to stable to another, until the inputs are changed.

41) List the different techniques used for state assignment.

1. Shared row state assignment

2. One hot state assignment.

42) Write a short note on fundamental mode asynchronous circuit.

Fundamental mode circuit assumes that. The input variables change only when the circuit is stable. Only one input variable can change at a given time and inputs are levels and not pulses.

43) Write a short note on pulse mode circuit.

Pulse mode circuit assumes that the input variables are pulses instead of level. The width of the pulses is long enough for the circuit to respond to the input and the pulse width must not be so long that it is still present after the new state is reached.

44) Define secondary variables

The delay elements provide a short term memory for the sequential circuit. The present state and next state variables in asynchronous sequential circuits are called secondary variables.

45) Define flow table in asynchronous sequential circuit.

In asynchronous sequential circuit state table is known as flow table because of the behavior of the asynchronous sequential circuit. The stage changes occur in independent of a clock, based on the logic propagation delay, and cause the states to .flow. From one to another.

46) What is fundamental mode?

A transition from one stable state to another occurs only in response to a change in the input state. After a change in one input has occurred, no other change in any input occurs until the circuit enters a stable state. Such a mode of operation is referred to as a fundamental mode.

47) Write short note on shared row state assignment.

Races can be avoided by making a proper binary assignmentto the state variables. Here, the state variables are assigned with binary numbers in such a way that only one state variable can change at any one state variable can change at any one time when a state transition occurs. To accomplish this, it is necessary that states between which transitions occur be given adjacent assignments. Two binary are said to be adjacent if they differ in only one variable.

48) Write short note on one hot state assignment.

The one hot state assignment is another method for finding a race free state assignment. In this method, only one variable is active or hot for each row in the original flow table, ie, it requires one state variable for each row of the flow table. Additional row are introduced to provide single variable changes between internal state transitions.

CS8391 - DATA STRUCTURES

UNIT I - LINEAR DATA STRUCTURES – LIST

1. Define Data Structures

Data Structures is defined as the way of organizing all data items that consider not only the elements stored but also stores the relationship between the elements.

2. Why do we need data structures?

Data structures allow us to achieve an important goal: component reuse. Once data structure has been implemented, it can be used again and again in various applications.

3. Define ADT(Abstract Data Type)

An abstract data type (ADT) is a set of operations and mathematical abstractions , which can be viewed as how the set of operations is implemented. Objects like lists, sets and graphs, along with their operation, can be viewed as abstract data types, just as integers, real numbers and Booleans.

4. Define List ADT

A list is a sequence of zero or more elements of a given type. The list is represented as sequence of elements separated by comma.

A1,A2,A3…..AN

Where N>0 and A is of type element.

5. Mention the features of ADT.

a. Modularity

i. Divide program into small functions

ii. Easy to debug and maintain

iii. Easy to modify

b. Reuse

i. Define some operations only once and reuse them in future

c. Easy to change the implementation

6. What are benefits of ADT?

a. Code is easier to understand

b. Implementation of ADT can be changed without requiring changes to the program that uses the ADT

7. List some common data structures.

- Stacks
- Queues
- Lists
- Trees
- Graphs
- Tables

8. How data structures are classified?

Data structures are classified into two categories based on how the data items are operated:

i. Primitive data structure

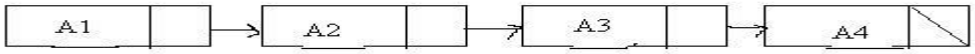
ii. Non-Primitive data structure

a. Linear data structure

b. Non-linear data structure

9. Define Linked Lists

Linked list consists of a series of structures, which are not necessarily adjacent in memory. Each structure contains the element and a pointer to a structure containing its successor. We call this theNext Pointer. The last cell'sNext pointer points to NULL.



10. What is an array?

Array may be defined abstractly as a finite ordered set of homogenous elements. Finite means there is a specific number of elements in the array.

11. Advantages and Disadvantages of arrays?

Advantages:

- Data accessing is faster
- Array‟s are simple-in terms of understanding point and in terms of programming.

Disadvantages:

- Array size is fixed
- Array elements stored continuously
- Insertion and deletion of elements in an array is difficult.

12. List down the applications of List.

- a. Representation of polynomial ADT
- b. Used in radix and bubble sorting
- c. In a FAT file system, the metadata of a large file is organized as a linked list of
- FAT entries.
- d. Simple memory allocators use a free list of unused memory regions, basically a
- linked list with the list pointer inside the free memory itself.

13. How to search an element in list.

Searching can be initiated from first node and it is compared with given element one after the other until the specified key is found or until the end of the list is encountered.

14. What is the need for the header?

Header of the linked list is the first element in the list and it stores the number of elements in the list. It points to the first data element of the list.

15. What is a linked list?

Linked list is a kind of series of data structures, which are not necessarily adjacent in memory. Each structure contains the element and a pointer to a record containing its successor.

16. What is singly linked list?

A singly linked list is a linked list, there exists only one link field in each and every node and all nodes are linked together in some sequential manner and this type of linked list is called singly linked list.

17. What is a doubly linked list?

In a simple linked list, there will be one pointer named as „NEXT POINTER‟ to point thenext element, where as in a doubly linked list, there will be two pointers one to point the next element and the other to point the previous element location.

18. What is a circular linked list?

A circular linked list is a special type of linked list that supports traversing from the end of the list to the beginning by making the last node point back to the head of the list.

19. Define double circularly linked list?

In a doubly linked list, if the last node or pointer of the list, point to the first element of the list, then it is a circularly linked list.

20. What are the ways of implementing linked list?

The list can be implemented in the following ways:

i. Array implementation

ii. Linked-list implementation

iii. Cursor implementation

21. List the basic operations carried out in a linked list

The basic operations carried out in a linked list include:

Creation of a list

Insertion of a node

Deletion of a node
Modification of a node
Traversal of the list

22. List out the advantages of using a linked list

It is not necessary to specify the number of elements in a linked list during its declaration
Linked list can grow and shrink in size depending upon the insertion and deletion that occurs in the list
Insertions and deletions at any place in a list can be handled easily and efficiently
A linked list does not waste any memory space

23. List out the disadvantages of using a linked list

Searching a particular element in a list is difficult and time consuming
A linked list will use more storage space than an array to store the same number of elements

24.What are the types of Linear linked list?

✓Singly linked lists
✓Circular singly linked lists
✓Doubly linked lists
✓Circular doubly linked lists

25. When doubly linked list can be represented as circular linked list?

In a doubly linked list, all nodes are connected with forward and backward links to the next and previous nodes respectively. In order to implement circular linked lists from doubly linked lists, the first node's previous field is connected to the last node and the last node's next field is connected to the first node.

26. Where cursor implementation can be used?

The cursor implementation of lists is used by many languages such as BASIC and FORTRAN that do not support pointers. The two important features of the cursor implementation of linked are as follows:

The data are stored in a collection of structures. Each structure contains data and a index to the next structure.

A new structure can be obtained from the system's global memory by a call to cursorSpace array.

27. What are the advantages of linked list?

a. Save memory space and easy to maintain
b. It is possible to retrieve the element at a particular index
c. It is possible to traverse the list in the order of increasing index.
d. It is possible to change the element at a particular index to a different value, without affecting any other elements.

28. What are the operations performed in list?

The following operations can be performed on a list
i. Insertion
a. Insert at beginning
b. Insert at end
c. Insert after specific node
d. Insert before specific node
ii. Deletion
a. Delete at beginning
b. Delete at end
c. Delete after specific node
d. Delete before specific node
iii. Merging
iv. Traversal

29. What are the merits and demerits of array implementation of lists?

Merits

- Fast, random access of elements
- Memory efficient – very less amount of memory is required

Demerits

- Insertion and deletion operations are very slow since the elements should be
- moved.
- Redundant memory space – difficult to estimate the size of array.

30. When singly linked list can be represented as circular linked list?

In a singly linked list, all the nodes are connected with forward links to the next nodes in the list. The last node has a next field, NULL. In order to implement the circularly linked lists from singly linked lists, the last node's next field is connected to the first node.

UNIT II - LINEAR DATA STRUCTURES – STACKS, QUEUES

1.What is a Stack ?

A stack is a non-primitive linear data structure and is an ordered collection of homogeneous data elements.The other name of stack is Last-in -First-out list.

One of the most useful concepts and frequently used data structure of variable size for problem solving is the stack.

2. What are the operations of the stack?

a. CreateStack/ InitStack(Stack) – creates an empty stack
b. Push(Item) – pushes an item on the top of the stack
c. Pop(Item) – removes the top most element from the stack
d. Top(Stack) – returns the first element from the stack
e. IsEmpty(Stack) – returns true if the stack is empty

3. How to implement stack using singly linked list

Stack is an Last In First Out (LIFO) data structure. Here , elements are inserted from one end called push operation and the same elements are deleted from the same end called pop operation

So, using singly linked list stack operations are performed in the front or other way ew can perform rear end also.

4. How the operations performed on linked list implementation of stack?

a. Push and pop operations at the head of the list
b. New nodes should be inserted at the front of the list, so that they become the top of the stack
c. Nodes are removed from the front(top) of the stack

5. What are the applications of stack?

The following are the applications of stacks
• Evaluating arithmetic expressions
• Balancing the parenthesis
• Towers of Hanoi
• Function calls
• Tree traversal

6.Write down the algorithm for solving Towers of Hanoi problem?

✓Push parameters and return address on stack.
✓If the stopping value has been reached then pop the stack to return to previous level else move all except the final disc from starting to intermediate needle.
✓Move final discs from start to destination needle.

7. Write the routine to pop a element from a stack.

```
int pop()
{
```

```
if(top==NULL)
{
printf("\n Stack is empty.\n");
getch();
exit(1);
}
else
{
int temp;
temp=top→element; /* retreiving the top element*/
top=top→next; /* Updating the stack pointer */
return temp; /* returning the popped value */
}
}
```

8. What are the operations of a queue?

The operations of a queue are

- isEmpty()
- isFull()
- insert()
- delete()
- display()

9. Write the routine to insert a element onto a queue.

```
void insert(int element)
{
if(front==-1 )
{
front = rear = front +1;
queue[front] = element;
return;
}
if(rear==99)
{
printf("Queue is full");
getch();
return;
}
rear = rear +1;
queue[rear]=element;
}
```

10. How the operations performed on linked list implementation of stack?

a. Push and pop operations at the head of the list

b. New nodes should be inserted at the front of the list, so that they become the top of the stack

c. Nodes are removed from the front(top) of the stack

11. What are the applications of stack?

The following are the applications of stacks

• Evaluating arithmetic expressions

• Balancing the parenthesis

• Towers of Hanoi

• Function calls

• Tree traversal

12. What are the methods to implement stack in C?

The methods to implement stacks are:

- Array based
- Linked list based

13. How the stack is implemented by linked list?

It involves dynamically allocating memory space at run time while performing stack operations.Since it consumes only that much amount of space is required for holding its data elements , it prevents wastage of memory space.

```
struct stack
{
int element;
struct stack *next;
}*top;
```

14. Define Dqueue?

Dqueue is also data structure where elements can be inserted from both ends and deleted from both ends. To implement a dqueue operations using singly linked list operations performed insert_front, delete_front, insert_rear, delete_rear and display functions.

15. How to implement stack using singly linked list

Stack is an Last In First Out (LIFO) data structure. Here , elements are inserted from one end called push operation and the same elements are deleted from the same end called pop operation

So, using singly linked list stack operations are performed in the front or other way ew can perform rear end also.

16.Write down the algorithm for solving Towers of Hanoi problem?

✓Push parameters and return address on stack.

✓If the stopping value has been reached then pop the stack to return to previous level else move all except the final disc from starting to intermediate needle.

✓Move final discs from start to destination needle.

UNIT III = NON LINEAR DATA STRUCTURES –TREES

1. Define Tree .Give an example.

A tree is a collection of nodes .The collection can be empty .Otherwise a tree consists of a distinguished node r called the root and 0 or more non empty sub-trees T1,T2,T3…….Tk each of whose roots are connected by a directed edge from r.

2.Write the routine for node declaration in trees.

```
typedefstructTreeNode *PtrToNode; struct
TreeNode
{
ElementType Element;
PtrToNodeFirstChild;
PtrToNodeNextSibling;
};
```

3. List the applications of trees.

• Binary search trees
• Expression trees
• Threaded binary trees

4. Define Binary tree.

A Binary tree is a tree in which no node can have more than two children.

5.List the tree traversal applications.

1. Listing a directory in an hierarchal file system (preorder)

2. Calculating the size of a directory (post order)

6. Define binary search tree?

Binary Search tree is a binary tree in which each internal node *x* stores an element such that the element stored in the left sub tree of *x* are less than or equal to *x* and elements stored in the right sub tree of *x* are greater than or equal to *x*. This is called binarysearch-tree

7. List the Operations of binary search tree?

- Make Empty
- Find
- Insert
- Delete
- Search
- Display

8.Define Threaded Binary tree.

A Threaded Binary Tree is a binary tree in which every node that does not have a right child has a THREAD (in actual sense, a link) to its INORDER successor. By doing this threading we avoid the recursive method of traversing a Tree, which makes use of stacks and consumes a lot of memory and time.

9.List the uses of binary tree.

1. Searching.
2. Compiler design.

10 .State the properties of a binary tree

- The maximum number of nodes on level n of a binary tree is 2n-1, where n≥1.
- The maximum number of nodes in a binary tree of height n is 2n-1, where n≥1.
- For any non-empty tree, nl=nd+1 where nl is the number of leaf nodes and nd is the number of nodes of degree 2.

11.What is meant by binary tree traversal?

Traversing a binary tree means moving through all the nodes in the binary tree, visiting each node in the tree only once.

12.What are the different binary tree traversal techniques?

- Preorder traversal
- Inorder traversal
- Postorder traversal

13.What are the tasks performed while traversing a binary tree?

- Visiting a node
- Traverse the left sub-tree
- Traverse the right sub-tree

14.What are the tasks performed during preorder traversal?

- Process the root node
- Traverse the left sub-tree
- Traverse the right sub-tree

Routine:

```
void preorder(node *temp)
{
if(temp!=NULL)
{
printf("%d",temp->data);
preorder(temp->left);
preorder(temp->right);
}
}
```

15.What are the tasks performed during inorder traversal?

 Traverse the left sub-tree
 Process the root node
 Traverse the right sub-tree

Routine:

```
voidinorder(node *temp)
{
if (temp!=NULL)
{
inorder(temp->left);
printf("%d",temp->data);
inorder(temp->right);
}
}
```

16.What are the tasks performed during postorder traversal?

 Traverse the left sub-tree
 Traverse the right sub-tree
 Process the root node

ROUTINE:

```
voidpostorder(node *temp)
{
if(temp!=NULL)
{
postorder(temp->left);
postorder(temp->right);
printf("%d",temp->data);
}
}
```

17.State the merits of linear representation of binary trees.

 Storage method is easy and can be easily implemented in arrays
When the location of a parent/child node is known, other one can be determined easily
It requires static memory allocation so it is easily implemented in all programming Language

18.State the demerit of linear representation of binary trees.

Insertions and deletions in a node take an excessive amount of processing time due to data movement up and down the array.

19.State the merit of linked representation of binary trees.

Insertions and deletions in a node involve no data movement except the rearrangement of pointers, hence less processing time.

20.State the demerits of linked representation of binary trees.

Given a node structure, it is difficult to determine its parent node
 Memory spaces are wasted for storing null pointers for the nodes, which have one or no sub-trees
It requires dynamic memory allocation, which is not possible in some programming language

21.What do you mean by general trees?

General tree is a tree with nodes having any number of children.

22. Define ancestor and descendant

If there is a path from node n1 to n2, then n1 is the ancestor of n2 and n2 is the descendant of n1.

23. Why it is said that searching a node in a binary search tree is efficient than that of a simple

binary tree?

In binary search tree, the nodes are arranged in such a way that the left node is having less data value than root node value and the right nodes are having larger value than that of root. Because of this while searching any node the value of the target node will be compared with the parent node and accordingly either left sub branch or right sub branch will be searched. So, one has to compare only particular branches. Thus searching becomes efficient.

24. What is an expression tree?

An expression tree is a tree which is build from infix or prefix or postfix expression. Generally, in such a tree, the leaves are operands and other nodes are operators.

25. Define right-in threaded tree

Right-in threaded binary tree is defined as one in which threads replace NULL pointers in nodes with empty right sub-trees.

26. Define left-in threaded tree

Left-in threaded binary tree is defined as one in which each NULL pointers is altered to contain a thread to that node's inorder predecessor.

27.Define AVL Tree. Give Example.

An AVL Tree is a binary search tree with a balance condition, which is easy to maintain and ensure that the depth of the tree is O(log N). Balance condition require that the left and the right sub trees have the same height.

28.Define Balance factor.

The balance factor of a node in binary tree is defined to be hR- hL where hL and hR are heights of left and right subtrees of T. For any node in AVL tree the balance factor should be 1,0 or -1.

29.When AVL tree property is violated and how to solve it?

After insertion of any node in an AVL tree if the balance factor of any node becomes other than -1,0, or 1 then it is said that AVL property is violated. So the node on the path from the inserted node to the root needs to be readjusted. Check the balance factor for each node in the path from inserted node to the root node and adjust the affected subtree such that the entire subtree should satisfy the AVL property.

30.When AVL tree property is violated and how to solve it?

After insertion of any node in an AVL tree if the balance factor of any node becomes other than -1,0, or 1 then it is said that AVL property is violated. So the node on the path from the inserted node to the root needs to be readjusted. Check the balance factor for each node in the path from inserted node to the root node and adjust the affected subtree such that the entire subtree should satisfy the AVL property.

31.Mention the four cases to rebalance the AVL tree.

 An insertion of new node into Left subtree of Left child(LL).
 An insertion of new node into Right subtree of Left child(LR).
 An insertion of new node into Left subtree of Right child(RL).
 An insertion of new node into Right subtree of Right child(RR).

32.Define Rotation in AVL tree. Mention the two types of rotations.

Some modifications done on AVL tree in order to rebalance it is called Rotation of AVL tree.

The two types of rotations are

- Single Rotation
  - o Left-Left Rotation
  - o Right-Right Rotation
- Double Rotation
  - o Left-Right Rotation
  - o Right-Left Rotation

33.Define Splay Tree.

A splay tree is a self-balancing binary search tree with the additional property that recently accessed elements are quick to access again. It performs basic operations such as insertion, look-up and removal in O (log(n)) amortized time. For many non-uniform sequences of operations, splay trees perform better than other search trees, even when the specific pattern of the sequence is unknown.

34.List the types of rotations available in Splay tree.

Let us assume that the splay is performed at vertex v, whose parent and grandparent are p and g respectively. Then, the three rotations are named as:

Zig: If p is the root and v is the left child of p, then left-left rotation at p would suffice. This case always terminates the splay as v reaches the root after this rotation.

Zig-Zig: If p is not the root, p is the left child and v is also a left child, then a left-left rotation at g followed by a left-left rotation at p, brings v as an ancestor of g as well as p.

Zig-Zag: If p is not the root, p is the left child and v is a right child, perform a left-right rotation at g and bring v as an ancestor of p as well as g.

35.Define B-tree of order M.

A B-tree of order M is a tree that is not binary with the following structural properties:

- The root is either a leaf or has between 2 and M children.
- All non-leaf nodes (except the root) have between ┌M/2┐ and M children.
- All leaves are at the same depth.

36.What do you mean by 2-3 tree?

A B-tree of order 3 is called 2-3 tree. A B-tree of order 3 is a tree that is not binary with the following structural properties:

- The root is either a leaf or has between 2 and 3 children.
- All non-leaf nodes (except the root) have between 2 and 3 children.
- All leaves are at the same depth.

37.What do you mean by 2-3-4 tree?

A B-tree of order 4 is called 2-3-4 tree. A B-tree of order 4 is a tree that is not binary with the following structural properties:

- The root is either a leaf or has between 2 and 4 children.
- All non-leaf nodes (except the root) have between 2 and 4 children.
- All leaves are at the same depth.

38.What are the applications of B-tree?

- Database implementation
- Indexing on non primary key fields

UNIT IV - NON LINEAR DATA STRUCTURES – GRAPHS

1. Define Graph.

A graph G consist of a nonempty set V which is a set of nodes of the graph, a set E which is the set of edges of the graph, and a mapping from the set for edge E to a set of pairs of elements of V. It can also be represented as G=(V, E).

2. Define adjacent nodes.

Any two nodes which are connected by an edge in a graph are called adjacent nodes. For example, if an edge x ε E is associated with a pair of nodes (u,v) where u, v ε V, then we say that the edge x connects the nodes u and v.

3. What is a directed graph?

A graph in which every edge is directed is called a directed graph.

4. What is an undirected graph?

A graph in which every edge is undirected is called a directed graph.

5. What is a loop?

An edge of a graph which connects to itself is called a loop or sling.

6. What is a simple graph?

A simple graph is a graph, which has not more than one edge between a pair of nodes than such a graph is called a simple graph.

7. What is a weighted graph?

A graph in which weights are assigned to every edge is called a weighted graph.

8. Define outdegree of a graph?

In a directed graph, for any node v, the number of edges which have v as their initial node is called the out degree of the node v.

9. Define indegree of a graph?

In a directed graph, for any node v, the number of edges which have v as their terminal node is called the indegree of the node v.

10. Define path in a graph?

The path in a graph is the route taken to reach terminal node from a starting node.

11. What is a simple path?

A path in a diagram in which the edges are distinct is called a simple path. It is also called as edge simple.

12. What is a cycle or a circuit?

A path which originates and ends in the same node is called a cycle or circuit.

13. What is an acyclic graph?

A simple diagram which does not have any cycles is called an acyclic graph.

14. What is meant by strongly connected in a graph?

An undirected graph is connected, if there is a path from every vertex to every other vertex. A directed graph with this property is called strongly connected.

15. When is a graph said to be weakly connected?

When a directed graph is not strongly connected but the underlying graph is connected, then the graph is said to be weakly connected.

16.Namethe different ways of representing a graph?

a.Adjacencymatrix

b. Adjacency list

17. What is an undirected acyclic graph?

When every edge in an acyclic graph is undirected, it is called an undirected acyclic graph. It is also called as undirected forest.

18. What are the two traversal strategies used in traversing a graph?

a.Breadthfirstsearch

b. Depth first search

19. What is a minimum spanning tree?

A minimum spanning tree of an undirected graph G is a tree formed from graph edges that connects all the vertices of G at the lowest total cost.

20. Name two algorithms two find minimum spanning tree

Kruskal’salgorithm

Prim’s algorithm

21. Define graph traversals.

Traversing a graph is an efficient way to visit each vertex and edge exactly once.

22. List the two important key points of depth first search.

i) If path exists from one node to another node, walk across the edge – exploring the edge.

ii) If path does not exist from one specific node to any other node, return to the previous node where we have been before – backtracking.

23. What do you mean by breadth first search (BFS)?

BFS performs simultaneous explorations starting from a common point and spreading out independently.

24. What do you mean by tree edge?

If w is undiscovered at the time vw is explored, then vw is called a tree edge and

v becomes the parent of w.

25. What do you mean by back edge?

If w is the ancestor of v, then vw is called a back edge.

26. Define biconnectivity.

A connected graph G is said to be biconnected, if it remains connected after removal of any one vertex and the edges that are incident upon that vertex. A connected graph is biconnected, if it has no articulation points.

27. What do you mean by articulation point?

If a graph is not biconnected, the vertices whose removal would disconnect the graph are known as articulation points.

28. What do you mean by shortest path?

A path having minimum weight between two vertices is known as shortest path, in which weight is always a positive number.

29. Define Activity node graph.

Activity node graphs represent a set of activities and scheduling constraints. Each node represents an activity (task), and an edge represents the next activity.

30. Define adjacency list.

Adjacency list is an array indexed by vertex number containing linked lists. Each node Vi theith array entry contains a list with information on all edges of G that leave Vi. It is used to represent the graph related problems.

UNIT V - SEARCHING, SORTING AND HASHING TECHNIQUES

1. What is meant by Sorting and searching?

Sorting and searching are fundamentals operations in computer science. Sorting refers to the operation of arranging data in some given order

Searching refers to the operation of searching the particular record from the existing information

2.What are the types of sorting available in C?

✓Insertion sort
✓Merge Sort
✓Quick Sort
✓Radix Sort
✓Heap Sort
✓Selection sort
✓Bubble sort

2.Define sorting?

Sorting arranges the numerical and alphabetical data present in a list in a specific order or sequence. There are a number of sorting techniques available. The algorithms can be chosen based on the following factors

– Size of the data structure
– Algorithm efficiency
– Programmer’s knowledge of the technique.

3. Mention the types of sorting

Internal sorting
External sorting

4. What do you mean by internal and external sorting?

An **internal sort** is any data sorting process that takes place entirely within the main memory of a computer. This is possible whenever the data to be sorted is small enough to all be held in the main memory.

External sorting is a term for a class of sorting algorithms that can handle massive amounts of data. External sorting is required when the data being sorted do not fit into the main memory of a computing device (usually RAM) and instead they must reside in the slower external memory (usually a hard drive)

5. Define bubble sort

Bubble sort is a simple sorting algorithm that works by repeatedly stepping through the list to be sorted, comparing each pair of adjacent items and swapping them if they are in the wrong order. The pass through the list is repeated until no swaps are needed, which indicates that the list is sorted. The algorithm gets its name from the way smaller elements "bubble" to the top of the list.

6. How the insertion sort is done with the array?

It sorts a list of elements by inserting each successive element in the previously sorted sublist.

Consider an array to be sorted A[1],A[2],….A[n]

a. Pass 1 : A[2] is compared with A[1] and placed them in sorted order.

b. Pass 2 : A[3] is compared with both A[1] and A[2] and inserted at an appropriate place. This makes A[1], A[2],A[3] as a sorted sub array.

c. Pass n-1 : A[n] is compared with each element in the sub array A[1],A[2],……A[n-1] and inserted at an appropriate position.

7. What is meant by shell sort?

Shell sort, also known as **Shell sort** or **Shell's method**, is an in-place comparison sort. It can either be seen as a generalization of sorting by exchange (bubble sort) or sorting by insertion (insertion sort).[1] The method starts by sorting elements far apart from each other and progressively reducing the gap between them. Starting with far apart elements can move some out-of-place elements into position faster than a simple nearest neighbor exchange. Donald Shell published the first version of this sort in 1959. The running time of Shell sort is heavily dependent on the gap sequence it uses

8. What are the steps in quick sort?

The steps are:

a. Pick an element, called a **pivot**, from the list.

b. Reorder the list so that all elements with values less than the pivot come before the pivot, while all elements with values greater than the pivot come after it (equal values can go either way). After this partitioning, the pivot is in its final position. This is called the **partition** operation.

c. Recursively apply the above steps to the sub-list of elements with smaller values and separately to the sub-list of elements with greater values.

9. Define radix sort

Radix Sort is a clever and intuitive little sorting algorithm. **Radix sort** is a noncomparative integer sorting algorithm that sorts data with integer keys by grouping keys by the individual digits which share the same significant position and value. Radix Sort puts the elements in order by comparing the **digits of the numbers**.

10. What are the steps for selection sort?

- The algorithm divides the input list into two parts: the sublist of items already sorted, which is built up from left to right at the front (left) of the list, and the sublist of items remaining to be sorted that occupy the rest of the list.
- Initially, the sorted sublist is empty and the unsorted sublist is the entire input list.
- The algorithm proceeds by finding the smallest (or largest, depending on sorting order) element in the unsorted sublist, exchanging it with the leftmost unsorted element (putting it in sorted order), and moving the sublist boundaries one element to the right.

11. What are the advantages of insertion sort

Advantages

a. Simplest sorting technique and easy to implement

b. It performs well in the case of smaller lists.

c. It leverages the presence of any existing sort pattern in the list

Disadvantages

 Efficiency of O(n) is not well suited for large sized lists
It requires large number of elements to be shifted

12. Define searching

Searching refers to determining whether an element is present in a given list of elements or not. If the element is present, the search is considered as successful, otherwise it is considered as an unsuccessful search. The choice of a searching technique is based on the following factors

a. Order of elements in the list i.e., random or sorted

b. Size of the list

13.Mention the various types of searching techniques in C

✓Linear search

✓Binary search

14.What is linear search?

In Linear Search the list is searched sequentially and the position is returned if the key element to be searched is available in the list, otherwise -1 is returned. The search in Linear Search starts at the beginning of an array and move to the end, testing for a match at each item.

15. What is binary search?

Binary search is simpler and faster than linear search. Binary search the array to be searched is divided into two parts, one of which is ignored as it will not contain the required element

One essential condition for the binary search is that the array which is to be searched, should be arranged in order.

16. Define merge sort?

Merge sort is based on divide and conquer method. It takes the list to be stored and divide it in half to create two unsorted lists.

The two unsorted lists are then sorted and merge to get a sorted list.

17. What is the basic idea of shell sort?

Shell sort works by comparing elements that are distant rather than adjacent elements in an array or list where adjacent elements are compared.

Shell sort uses an increment sequence. The increment size is reduced after each pass until increment size is 1.

18.What is the purpose of quick sort and advantage?

✓The purpose of the quick sort is to move a data item in the correct direction, just enough for to reach its final place in the array.

✓Quick sort reduces unnecessary swaps and moves an item to a greater distance, in one move.

19. Define Hashing.

Hashing is the transformation of string of characters into a usually shorter fixed length value or key that represents the original string. Hashing is used to index and retrieve items in a database because it is faster to find the item using the short hashed key than to find it using the original value.

20. What do you mean by hash table?

The hash table data structure is merely an array of some fixed size, containing the keys. A key is a string with an associated value. Each key is mapped into some number in the range 0 to tablesize-1 and placed in the appropriate cell.

21. What do you mean by hash function?

A hash function is a key to address transformation which acts upon a given key to compute the relative position of the key in an array. The choice of hash function should be simple and it must distribute the data evenly. A simple hash function is hash_key=key mod tablesize.

22. Write the importance of hashing.

• Maps key with the corresponding value using hash function.

• Hash tables support the efficient addition of new entries and the time spent on searching for the required data is independent of the number of items stored.

23. List out the different types of hashing functions?
The different types of hashing functions are,
✓The division method
✓The mind square method
✓The folding method
✓Multiplicative hashing
✓Digit analysis
24.What are the types of hashing?
✓Static hashing-In static hashing the process is carried out without the usage of an index structure.
✓Dynamic hashing- It allows dynamic allocation of buckets, i.e. according to the demand of database the buckets can be allocated making this approach more efficient.

25. What do you mean by collision in hashing?
When an element is inserted, it hashes to the same value as an already inserted element, and then it produces collision.
26. What are the collision resolution methods?
• Separate chaining or External hashing
• Open addressing or Closed hashing
27. What do you mean by separate chaining?
Separate chaining is a collision resolution technique to keep the list of all elements that hash to the same value. This is called separate chaining because each hash table element is a separate chain (linked list). Each linked list contains all the elements whose keys hash to the same index.
28.Define Rehashing?
Rehashing is technique also called as double hashing used in hash tables to resolve hash collisions, cases when two different values to be searched for produce the same hash key.
It is a popular collision-resolution technique in open-addressed hash tables.
29. Write the advantage of separate chaining.
• More number of elements can be inserted as it uses linked lists.
30. Write the disadvantages of separate chaining.
• The elements are evenly distributed. Some elements may have more elements and some may not have anything.
• It requires pointers. This leads to slow the algorithm down a bit because of the time required to allocate new cells, and also essentially requires the implementation of a second data structure.
31. What do you mean by open addressing?
Open addressing is a collision resolving strategy in which, if collision occurs alternative cells are tried until an empty cell is found. The cells h0(x), h1(x), h2(x),…. are tried in succession, where hi(x)=(Hash(x)+F(i))mod Tablesize with F(0)=0. The function F is the collision resolution strategy.
32. What are the types of collision resolution strategies in open addressing?
• Linear probing
• Quadratic probing
• Double hashing
33. What do you mean by Probing?
Probing is the process of getting next available hash table array cell.
34. What do you mean by linear probing?
Linear probing is an open addressing collision resolution strategy in which F is a linear function of i, F(i)=i. This amounts to trying sequentially in search of an empty cell. If the table is big enough, a free cell can always be found, but the time to do so can get quite large.
35. What do you mean by primary clustering?
In linear probing collision resolution strategy, even if the table is relatively

empty, blocks of occupied cells start forming. This effect is known as primary clustering means that any key hashes into the cluster will require several attempts to resolve the collision and then it will add to the cluster.

36. What do you mean by quadratic probing?

Quadratic probing is an open addressing collision resolution strategy in which F(i)=i2. There is no guarantee of finding an empty cell once the table gets half full if the table size is not prime. This is because at most half of the table can be used as alternative locations to resolve collisions.

37. What do you mean by secondary clustering?

Although quadratic probing eliminates primary clustering, elements that hash to the same position will probe the same alternative cells. This is known as secondary clustering.

38. What do you mean by double hashing?

Double hashing is an open addressing collision resolution strategy in which F(i)=i.hash2(X). This formula says that we apply a second hash function to X and probe at a distance hash2(X), 2hash2(X),….,and so on. A function such as hash2(X)=R-(XmodR), with R a prime smaller than Tablesize.

39. What is the need for extendible hashing?

If either open addressing hashing or separate chaining hashing is used, the major problem is that collisions could cause several blocks to be examined during a Find, even for a welldistributed hash table. Extendible hashing allows a find to be performed in two disk accesses. Insertions also require few disk accesses.

40. List the limitations of linear probing.

• Time taken for finding the next available cell is large.
• In linear probing, we come across a problem known as clustering.

41. Mention one advantage and disadvantage of using quadratic probing.

Advantage: The problem of primary clustering is eliminated.
Disadvantage: There is no guarantee of finding an unoccupied cell once the table is nearly half full.

42. Mention the types of searching

The types are
Linear search
Binary search

43. What is meant by linear search?

Linear search or **sequential search** is a method for finding a particular value in a list that consists of checking every one of its elements, one at a time and in sequence, until the desired one is found.

44. What is binary search?

For binary search, the array should be arranged in ascending or descending order.
In each step, the algorithm compares the search key value with the middle element of the array. If the key match, then a matching element has been found and its index, or position, is returned.
Otherwise, if the search key is less than the middle element, then the algorithm repeats its action on the sub-array to the left of the middle element or, if the search key is greater, on the sub-array to the right.

45. Define hashing function

A hashing function is a key-to-transformation, which acts upon a given key to compute the relative position of the key in an array.
A simple hash function
HASH(KEY_Value)= (KEY_Value)mod(Table-size)

46. What is open addressing?

Open addressing is also called closed hashing, which is an alternative to resolve the collisions with linked lists. In this hashing system, if a collision occurs, alternative cells

are tired until an empty cell is found.
There are three strategies in open addressing:
- Linear probing
- Quadratic probing
- Double hashing

47. What are the collision resolution methods?

The following are the collision resolution methods
- Separate chaining
- Open addressing
- Multiple hashing

48. Define separate chaining

It is an open hashing technique. A pointer field is added to each record location, when an overflow occurs, this pointer is set to point to overflow blocks making a linked list.
In this method, the table can never overflow, since the linked lists are only extended upon the arrival of new keys.

UNIT I – INTRODUCTION TO OOP AND JAVA FUNDAMENTALS

1) What is meant by Object Oriented Programming?

OOP is a method of programming in which programs are organised as cooperative collections of objects. Each object is an instance of a class and each class belong to a hierarchy.

2) What is a Class?

Class is a template for a set of objects that share a common structure and a common behaviour.

3) What is an Object?

Object is an instance of a class. It has state,behaviour and identity. It is also called as an instance of a class.

4) What is an Instance?

An instance has state, behaviour and identity. The structure and behaviour of similar classes are defined in their common class. An instance is also called as an object.

5) What are the core OOP's concepts?

Abstraction, Encapsulation,Inheritance and Polymorphism are the core OOP's concepts.

6) What is meant by abstraction?

Abstraction defines the essential characteristics of an object that distinguish it from all other kinds of objects. Abstraction provides crisply-defined conceptual boundaries relative to the perspective of the viewer. Its the process of focussing on the essential characteristics of an object. Abstraction is one of the fundamental elements of the object model.

7) What is meant by Encapsulation?

Encapsulation is the process of compartmentalising the elements of an abtraction that defines the structure and behaviour. Encapsulation helps to separate the contractual interface of an abstraction and implementation.

8) What are Encapsulation, Inheritance and Polymorphism?

Encapsulation is the mechanism that binds together code and data it manipulates and keeps both safe from outside interference and misuse. Inheritance is the process by which one object acquires the properties of another object. Polymorphism is the feature that allows one interface to be used for general class actions.

9) What are methods and how are they defined?

Methods are functions that operate on instances of classes in which they are defined. Objects can communicate with each other using methods and can call methods in other classes. Method definition has four parts. They are name of the method, type of object or primitive type the method returns, a list of parameters and the body of the method. A method's signature is a combination of the first three parts mentioned above.

10) What are different types of access modifiers (Access specifiers)?

Access specifiers are keywords that determine the type of access to the member of a class. These keywords are for allowing privileges to parts of a program such as functions and variables. These are:
public: Any thing declared as public can be accessed from anywhere.

private: Any thing declared as private can't be seen outside of its class.

protected: Any thing declared as protected can be accessed by classes in the same package and subclasses in the other packages.

default modifier : Can be accessed only to classes in the same package.

11) What is an Object and how do you allocate memory to it?

Object is an instance of a class and it is a software unit that combines a structured set of data with a set of operations for inspecting and manipulating that data. When an object is created using new operator, memory is allocated to it.

12) **Explain the usage of Java packages.**

This is a way to organize files when a project consists of multiple modules. It also helps resolve naming conflicts when different packages have classes with the same names. Packages access level also allows you to protect data from being used by the non-authorized classes.

13) What is method overloading and method overriding?

Method overloading: When a method in a class having the same method name with different arguments is said to be method overloading. Method overriding : When a method in a class having the same method name with same arguments is said to be method overriding.

14) What gives java it's "write once and run anywhere" nature?

All Java programs are compiled into class files that contain bytecodes. These byte codes can be run in any platform and hence java is said to be platform independent.

15) What is a constructor? What is a destructor?

Constructor is an operation that creates an object and/or initialises its state. Destructor is an operation that frees the state of an object and/or destroys the object itself. In Java, there is no concept of destructors. Its taken care by the JVM.

16) What is the difference between constructor and method? Constructor will be automatically invoked when an object is created whereas method has to be called explicitly.

17) What is Static member classes?

A static member class is a static member of a class. Like any other static method, a static member class has access to all static methods of the parent, or top-level, class.

18) What is Garbage Collection and how to call it explicitly? \

When an object is no longer referred to by any variable, java automatically reclaims memory used by that object. This is known as garbage collection. System. gc() method may be used to call it explicitly

19) In Java, How to make an object completely encapsulated?

All the instance variables should be declared as private and public getter and setter methods should be provided for accessing the instance variables.

20) What is static variable and static method?

static variable is a class variable which value remains constant for the entire class static method is the one which can be called with the class itself and can hold only the staic variables.

21) What is finalize() method?

finalize () method is used just before an object is destroyed and can be called just prior to garbage collection.

22) What is the difference between String and String Buffer?

a) String objects are constants and immutable whereas StringBuffer objects are not. b) String class supports constant strings whereas StringBuffer class supports growable and modifiable strings.

23) What is the difference between Array and vector?

Array is a set of related data type and static whereas vector is a growable array of objects and dynamic

24) What is a package?

A package is a collection of classes and interfaces that provides a high-level layer of access protection and name space management.

25) What is the difference between this() and super()?

this() can be used to invoke a constructor of the same class whereas super() can be used to invoke a super class constructor.

26) Explain working of Java Virtual Machine (JVM)?

JVM is an abstract computing machine like any other real computing machine which first converts .java file into .class file by using Compiler (.class is nothing but byte code file.) and Interpreter reads byte codes

UNIT II - INHERITANCE AND INTERFACES

1) What is meant by Inheritance?

Inheritance is a relationship among classes, wherein one class shares the structure or behaviour defined in another class. This is called Single Inheritance. If a class shares the structure or behaviour from multiple classes, then it is called Multiple Inheritance. Inheritance defines “is-a” hierarchy among classes in which one subclass inherits from one or more generalised superclasses.

2) What is meant by Inheritance and what are its advantages?

Inheritance is the process of inheriting all the features from a class. The advantages of inheritance are reusability of code and accessibility of variables and methods of the super class by subclasses.

3) What is the difference between superclass and subclass?

A super class is a class that is inherited whereas sub class is a class that does the inheriting.

4) **Differentiate between a Class and an Object?**

The Object class is the highest-level class in the Java class hierarchy. The Class class is used to represent the classes and interfaces that are loaded by a Java program. The Class class is used to obtain information about an object's design. A Class is only a definition or prototype of real life object. Whereas an object is an instance or

living representation of real life object. Every object belongs to a class and every class contains one or more related objects.

5) What is meant by Binding?

Binding denotes association of a name with a class

6) What is meant by Polymorphism?

Polymorphism literally means taking more than one form. Polymorphism is a characteristic of being able to assign a different behavior or value in a subclass, to something that was declared in a parent class.

7) What is Dynamic Binding?

Binding refers to the linking of a procedure call to the code to be executed in response to the call. Dynamic binding (also known as late binding) means that the code associated with a given procedure call is not known until the time of the call at run-time. It is associated with polymorphism and inheritance.

8) What is final modifier?

The final modifier keyword makes that the programmer cannot change the value anymore. The actual meaning depends on whether it is applied to a class, a variable, or a method.

final Classes- A final class cannot have subclasses.
final Variables- A final variable cannot be changed once it is initialized.
final Methods- A final method cannot be overridden by subclasses.

9) What is an Abstract Class?

Abstract class is a class that has no instances. An abstract class is written with the expectation that its concrete subclasses will add to its structure and behaviour, typically by implementing its abstract operations.

10) What are inner class and anonymous class?

Inner class: classes defined in other classes, including those defined in methods are called inner classes. An inner class can have any accessibility including private. Anonymous class: Anonymous class is a class defined inside a method without a name and is instantiated and declared in the same place and cannot have explicit constructors

11) What is an Interface?

Interface is an outside view of a class or object which emphaizes its abstraction while hiding its structure and secrets of its behaviour.

12) What is a base class?

Base class is the most generalised class in a class structure. Most applications have such root classes. In Java, Object is the base class for all classes.

13) What is reflection in java?

Reflection allows Java code to discover information about the fields, methods and constructors of loaded classes and to dynamically invoke them.

14) Define superclass and subclass?

Superclass is a class from which another class inherits. Subclass is a class that inherits from one or more classes.

15) What is meant by Binding, Static binding, Dynamic binding?

Binding: Binding denotes association of a name with a class.

Static binding: Static binding is a binding in which the class association is made during compile time. This is also called as *Early* binding.

Dynamic binding: Dynamic binding is a binding in which the class association is not made until the object is created at execution time. It is also called as *Late* binding.

16) What is reflection API? How are they implemented?

Reflection is the process of introspecting the features and state of a class at runtime and dynamically manipulate at run time. This is supported using Reflection API with built-in classes like Class, Method, Fields, Constructors etc. Example: Using Java Reflection API we can get the class name, by using the getName method.

17) What is the difference between a static and a non-static inner class?

A non-static inner class may have object instances that are associated with instances of the class's outer class. A static inner class does not have any object instances.

18) What is the difference between abstract class and interface?

a) All the methods declared inside an interface are abstract whereas abstract class must have at least one abstract method and others may be concrete or abstract.b) In abstract class, key word abstract must be used for the methods whereas interface we need not use that keyword for the methods. c) Abstract class must have subclasses whereas interface can't have subclasses.

19) Can you have an inner class inside a method and what variables can you access?

Yes, we can have an inner class inside a method and final variables can be accessed.

20) What is interface and its use? Interface is similar to a class which may contain method's signature only but not bodies and it is a formal set of method and constant declarations that must be defined by the class that implements it. Interfaces are useful for:

a) Declaring methods that one or more classes are expected to implement.b) Capturing similarities between unrelated classes without forcing a class relationship. c) Determining an object's programming interface without revealing the actual body of the class.

21) How is polymorphism acheived in java?

Inheritance, Overloading and Overriding are used to acheive Polymorphism in java.

22) What modifiers may be used with top-level class?

public, abstract and final can be used for top-level class.

23) What is a cloneable interface and how many methods does it contain?

It is not having any method because it is a TAGGED or MARKER interface.

24) What are the methods provided by the object class?

The Object class provides five methods that are critical when writing multithreaded Java programs:

- notify
- notifyAll
- wait (three versions)

25) Define: Dynamic proxy.

A dynamic proxy is a class that implements a list of interfaces, which you specify at runtime when you create the proxy. To create a proxy, use the static method *java.lang.reflect.Proxy::newProxyInstance()*. This method takes three arguments:

- The class loader to define the proxy class
- An invocation handler to intercept and handle method calls
- A list of interfaces that the proxy instance implements

26) What is object cloning?

It is the process of duplicating an object so that two identical objects will exist in the memory at the same time.

UNIT III - EXCEPTION HANDLING AND I/O

1) What is the relationship between the Canvas class and the Graphics class?

A Canvas object provides access to a Graphics object via its paint() method.

2) How would you create a button with rounded edges?

There's 2 ways. The first thing is to know that a JButton's edges are drawn by a Border. so you can override the Button's paintComponent(Graphics) method and draw a circle or rounded rectangle (whatever), and turn off the border. Or you can create a custom border that draws a circle or rounded rectangle around any component and set the button's border to it.

3) What is the difference between the 'Font' and 'FontMetrics' class?

The Font Class is used to render 'glyphs' - the characters you see on the screen. FontMetrics encapsulates information about a specific font on a specific Graphics object. (width of the characters, ascent, descent)

4) What is the difference between the paint() and repaint() methods?

The paint() method supports painting via a Graphics object. The repaint() method is used to cause paint() to be invoked by the AWT painting thread.

5) Which containers use a border Layout as their default layout?

The window, Frame and Dialog classes use a border layout as their default layout.

6) What is the difference between applications and applets? a)Application must be run on local machine whereas applet needs no explicit installation on local machine. b)Application must be run explicitly within a java-compatible virtual machine whereas applet loads and runs itself automatically in a java-enabled browser. c)Application starts execution with its main method whereas applet starts execution with its init method. d)Application can run with or without graphical user interface whereas applet must run within a graphical user interface.

7) Difference between Swing and Awt?

AWT are heavy-weight componenets. Swings are light-weight components. Hence swing works faster than AWT.

8) What is a layout manager and what are different types of layout managers available in java AWT?

A layout manager is an object that is used to organize components in a container. The different layouts are available are FlowLayout, BorderLayout, CardLayout, GridLayout and GridBagLayout.

9) How are the elements of different layouts organized?

FlowLayout: The elements of a FlowLayout are organized in a top to bottom, left to right fashion.

BorderLayout: The elements of a BorderLayout are organized at the borders (North, South, East and West) and the center of a container.

CardLayout: The elements of a CardLayout are stacked, on top of the other, like a deck of cards.

GridLayout: The elements of a GridLayout are of equal size and are laid out using the square of a grid.

GridBagLayout: The elements of a GridBagLayout are organized according to a grid. However, the elements are of different size and may occupy more than one row or column of the grid. In addition, the rows and columns may have different sizes.

The *default* Layout Manager of Panel and Panel sub classes is FlowLayout.

10) Why would you use SwingUtilities.invokeAndWait or swingUtilities.invokeLater?

I want to update a Swing component but I'm not in a callback. If I want the update to happen immediately (perhaps for a progress bar component) then I'd use invokeAndWait. If I don't care when the update occurs, I'd use invokeLater.

11) What is an event and what are the models available for event handling?

An event is an event object that describes a state of change in a source. In other words, event occurs when an action is generated, like pressing button, clicking mouse, selecting a list, etc. There are two types of models for handling events and they are: a) event-inheritance model and b) event-delegation model

12) What is the difference between scrollbar and scrollpane?

A Scrollbar is a Component, but not a Container whereas Scrollpane is a Conatiner and handles its own events and perform its own scrolling.

13) Why won't the JVM terminate when I close all the application windows?

The AWT event dispatcher thread is not a daemon thread. You must explicitly call System.exit to terminate the JVM.

14) What is meant by controls and what are different types of controls in AWT?

Controls are components that allow a user to interact with your application and the AWT supports the following types of controls: Labels, Push Buttons, Check Boxes, Choice Lists, Lists, Scrollbars, and Text Components. These controls are subclasses of Component.

15) What is the difference between a Choice and a List?

A Choice is displayed in a compact form that requires you to pull it down to see the list of available choices. Only one item may be selected from a Choice. A List may be displayed in such a way that several List items are visible. A List supports the selection of one or more List items.

16) What is the purpose of the enableEvents() method?

The enableEvents() method is used to enable an event for a particular object. Normally,an event is enabled when a listener is added to an object for a particular event. The enableEvents() method is used by objects that handle events by overriding their eventdispatch methods.

17) What is the difference between the File and RandomAccessFile classes?

The File class encapsulates the files and directories of the local file system. The RandomAccessFile class provides the methods needed to directly access data contained in any part of a file.

18) What is the lifecycle of an applet?

init() method - Can be called when an applet is first loaded start() method - Can be called each time an applet is started. paint() method - Can be called when the applet is minimized or maximized. stop() method - Can be used when the browser moves off the applet's page. destroy() method - Can be called when the browser is finished with the applet.

19) What is the difference between a MenuItem and a CheckboxMenuItem?

The CheckboxMenuItem class extends the MenuItem class to support a menu item that may be checked or unchecked.

20) What class is the top of the AWT event hierarchy?

The java.awt.AWTEvent class is the highest-level class in the AWT event-class hierarchy.

21) What is source and listener? *source :* A source is an object that generates an event. This occurs when the internal state of that object changes in some way.

listener : A listener is an object that is notified when an event occurs. It has two major requirements. First, it must have been registered with one or more sources to receive notifications about specific types of events. Second, it must implement methods to receive and process these notifications.

22) Explain how to render an HTML page using only Swing.

Use a JEditorPane or JTextPane and set it with an HTMLEditorKit, then load the text into the pane.

23) How would you detect a keypress in a JComboBox?

This is a trick. most people would say 'add a KeyListener to the JComboBox' - but the right answer is 'add a KeyListener to the JComboBox's editor component.'

24) What an I/O filter?

An I/O filter is an object that reads from one stream and writes to another, usually altering the data in some way as it is passed from one stream to another.

25) How can I create my own GUI components?

Custom graphical components can be created by producing a class that inherits from java.awt.Canvas. Your component should override the paint method, just like an applet does, to provide the graphical features of the component.

UNIT IV - MULTITHREADING AND GENERIC PROGRAMMING

1) What is an exception?

An *exception* is an event, which occurs during the execution of a program, that disrupts the normal flow of the program's instructions.

2) What is error?

An Error indicates that a non-recoverable condition has occurred that should not be caught. Error, a subclass of Throwable, is intended for drastic problems, such as OutOfMemoryError, which would be reported by the JVM itself.

3) Which is superclass of Exception?

"Throwable", the parent class of all exception related classes.

4) What are the advantages of using exception handling?

Exception handling provides the following advantages over "traditional" error management techniques:

Separating Error Handling Code from "Regular" Code.
Propagating Errors Up the Call Stack.
Grouping Error Types and Error Differentiation.

5) What are the types of Exceptions in Java

There are two types of exceptions in Java, unchecked exceptions and checked exceptions.

Checked exceptions: A checked exception is some subclass of Exception (or Exception itself), excluding class RuntimeException and its subclasses. Each method must either handle all checked exceptions by supplying a catch clause or list each unhandled checked exception as a thrown exception.

Unchecked exceptions: All Exceptions that extend the RuntimeException class are unchecked exceptions. Class Error and its subclasses also are unchecked.

6) Why Errors are Not Checked?

A unchecked exception classes which are the *error* classes (Error and its subclasses) are exempted from compile-time checking because they can occur at many points in the program and recovery from them is difficult or impossible. A program declaring such exceptions would be pointlessly.

7) How does a try statement determine which catch clause should be used to handle an exception?

When an exception is thrown within the body of a try statement, the catch clauses of the try statement are examined in the order in which they appear. The first catch clause that is capable of handling the exception is executed. The remaining catch clauses are ignored.

8) What is the purpose of the finally clause of a try-catch-finally statement?

The finally clause is used to provide the capability to execute code no matter whether or not an exception is thrown or caught.

9) What is the difference between checked and Unchecked Exceptions in Java?

All predefined exceptions in Java are either a checked exception or an unchecked exception. Checked exceptions must be caught using try.. catch () block or we should throw the exception using throws clause. If you dont, compilation of program will fail.

10) What is the difference between exception and error?

The exception class defines mild error conditions that your program encounters. Exceptions can occur when trying to open the file, which does not exist, the network connection is disrupted, operands being manipulated are out of prescribed ranges, the class file you are interested in loading is missing. The error class defines serious error conditions that you should not attempt to recover from. In most cases it is advisable to let the program terminate when such an error is encountered.

11) What is the catch or declare rule for method declarations?

If a checked exception may be thrown within the body of a method, the method must either catch the exception or declare it in its throws clause.

12) When is the finally clause of a try-catch-finally statement executed?

The finally clause of the try-catch-finally statement is always executed unless the thread of execution terminates or an exception occurs within the execution of the finally clause.

13) **What if there is a break or return statement in try block followed by finally block?**

If there is a return statement in the try block, the finally block executes right after the return statement encountered, and before the return executes.

14) **What are the different ways to handle exceptions?**

There are two ways to handle exceptions:

Wrapping the desired code in a try block followed by a catch block to catch the exceptions.
List the desired exceptions in the throws clause of the method and let the caller of the method handle hose exceptions.

15) **How to create custom exceptions?**

By extending the Exception class or one of its subclasses.

Example:

```
class MyException extends Exception {
  public MyException() { super(); }
  public MyException(String s) { super(s); }
  }
```

16) **Can we have the try block without catch block?**

Yes, we can have the try block without catch block, but finally block should follow the try block.
Note: It is not valid to use a try clause without either a catch clause or a finally clause.

17) What is the difference between swing and applet?

Swing is a light weight component whereas Applet is a heavy weight Component. Applet does not require main method, instead it needs init method.

18) What is the use of assert keyword?

Assert keyword validates certain expressions. It replaces the if block effectively and throws an AssertionError on failure. The assert keyword should be used only for critical arguments (means without that the method does nothing).

19) How does finally block differ from finalize() method?

Finally block will be executed whether or not an exception is thrown. So it is used to free resoources. finalize() is a protected method in the Object class which is called by the JVM just before an object is garbage collected.

20) What is the difference between throw and throws clause?

throw is used to throw an exception manually, where as throws is used in the case of checked exceptions, to tell the compiler that we haven't handled the exception, so that the exception will be handled by the calling function.

21) What are the different ways to generate and Exception?

There are two different ways to generate an Exception.

1. Exceptions can be generated by the Java run-time system.
   Exceptions thrown by Java relate to fundamental errors that violate the rules of the Java language or the constraints of the Java execution environment.
2. Exceptions can be manually generated by your code.
   Manually generated exceptions are typically used to report some error condition to the caller of a method.

22) Where does Exception stand in the Java tree hierarchy?

- java.lang.**Object**
- java.lang.**Throwable**
- java.lang.**Exception**
- java.lang.**Error**

23) **What is StackOverflowError?**

The StackOverFlowError is an Error Object thorwn by the Runtime System when it Encounters that your application/code has ran out of the memory. It may occur in case of recursive methods or a large amount of data is fetched from the server and stored in some object. This error is generated by JVM.

e.g. void swap(){

swap();

}

24) **Explain the exception hierarchy in java.**

The hierarchy is as follows: Throwable is a parent class off all Exception classes. They are two types of Exceptions: Checked exceptions and UncheckedExceptions. Both type of exceptions extends Exception class

25) How do you get the descriptive information about the Exception occurred during the program execution?

All the exceptions inherit a method printStackTrace() from the Throwable class. This method prints the stack trace from where the exception occurred. It prints the most recently entered method first and continues down, printing the name of each method as it works its way down the call stack from the top.

UNIT V - EVENT DRIVEN PROGRAMMING

1) Explain different way of using thread?

The thread could be implemented by using runnable interface or by inheriting from the Thread class. The former is more advantageous, 'cause when you are going for multiple inheritance..the only interface can help.

2) What are the different states of a thread ?

The different thread states are ready, running, waiting and dead.

3) Why are there separate wait and sleep methods?

The static Thread.sleep(long) method maintains control of thread execution but delays the next action until the sleep time expires. The wait method gives up control over thread execution indefinitely so that other threads can run.

4) What is multithreading and what are the methods for inter-thread communication and what is the class in which these methods are defined?

Multithreading is the mechanism in which more than one thread run independent of each other within the process. wait (), notify () and notifyAll() methods can be used for inter-thread communication and these methods are in Object class. wait() : When a thread executes a call to wait() method, it surrenders the object lock and enters into a waiting state. notify() or notifyAll() : To remove a thread from the waiting state, some other thread must make a call to notify() or notifyAll() method on the same object.

5) What is synchronization and why is it important?

With respect to multithreading, synchronization is the capability to control the access of multiple threads to shared resources. Without synchronization, it is possible for one thread to modify a shared object while another thread is in the process of using or updating that object's value. This often leads to significant errors.

6) How does multithreading take place on a computer with a single CPU?

The operating system's task scheduler allocates execution time to multiple tasks. By quickly switching between executing tasks, it creates the impression that tasks execute sequentially.

7) What is the difference between process and thread?

Process is a program in execution whereas thread is a separate path of execution in a program.

8) What happens when you invoke a thread's interrupt method while it is sleeping or waiting?

When a task's interrupt() method is executed, the task enters the ready state. The next time the task enters the running state, an InterruptedException is thrown.

9) How can we create a thread?

A thread can be created by extending Thread class or by implementing Runnable interface. Then we need to override the method public void run().

10) What are three ways in which a thread can enter the waiting state?

A thread can enter the waiting state by invoking its sleep() method, by blocking on I/O, by unsuccessfully attempting to acquire an object's lock, or by invoking an object's wait() method. It can also enter the waiting state by invoking its (deprecated) suspend() method.

11) How can i tell what state a thread is in ?

Prior to Java 5, isAlive() was commonly used to test a threads state. If isAlive() returned false the thread was either new or terminated but there was simply no way to differentiate between the two.

12) What is synchronized keyword? In what situations you will Use it?

Synchronization is the act of serializing access to critical sections of code. We will use this keyword when we expect multiple threads to access/modify the same data. To understand synchronization we need to look into thread execution manner.

13) What is serialization?

Serialization is the process of writing complete state of java object into output stream, that stream can be file or byte array or stream associated with TCP/IP socket.

14) What does the Serializable interface do?

Serializable is a tagging interface; it prescribes no methods. It serves to assign the Serializable data type to the tagged class and to identify the class as one which the developer has designed for persistence. ObjectOutputStream serializes only those objects which implement this interface.

15) When you will synchronize a piece of your code?

When you expect your code will be accessed by different threads and these threads may change a particular data causing data corruption.

16) What is daemon thread and which method is used to create the daemon thread?

Daemon thread is a low priority thread which runs intermittently in the back ground doing the garbage collection operation for the java runtime system. setDaemon method is used to create a daemon thread.

17) What is the difference between yielding and sleeping?

When a task invokes its yield() method, it returns to the ready state. When a task invokes its sleep() method, it returns to the waiting state.

18) What is casting?

There are two types of casting, casting between primitive numeric types and casting between object references. Casting between numeric types is used to convert larger values, such as double values, to smaller values, such as byte values. Casting between object references is used to refer to an object by a compatible class, interface, or array type reference.

19) What classes of exceptions may be thrown by a throw statement?

A throw statement may throw any expression that may be assigned to the Throwable type.

20) A Thread is runnable, how does that work?

The Thread class' run method normally invokes the run method of the Runnable type it is passed in its constructor. However, it is possible to override the thread's run method with your own.

21) Can I implement my own start() method?

The Thread start() method is not marked final, but should not be overridden. This method contains the code that creates a new executable thread and is very specialised. Your threaded application should either pass a Runnable type to a new Thread, or extend Thread and override the run() method.

22) Do I need to use synchronized on setValue(int)?

It depends whether the method affects method local variables, class static or instance variables. If only method local variables are changed, the value is said to be *confined* by the method and is not prone to threading issues.

23) What is thread priority?

Thread Priority is an integer value that identifies the relative order in which it should be executed with respect to others. The thread priority values ranging from 1- 10 and the default value is 5. But if a thread have higher priority doesn't means that it will execute first. The thread scheduling depends on the OS.

24) What are the different ways in which a thread can enter into waiting state?

There are three ways for a thread to enter into waiting state. By invoking its sleep() method, by blocking on I/O, by unsuccessfully attempting to acquire an object's lock, or by invoking an object's wait() method.

25) How would you implement a thread pool?

The ThreadPool class is a generic implementation of a thread pool, which takes the following input Size of the pool to be constructed and name of the class which implements Runnable (which has a visible default constructor) and constructs a thread pool with active threads that are waiting for activation. once the threads have finished processing they come back and wait once again in the pool.

26) What is a thread group?

A thread group is a data structure that controls the state of collection of thread as a whole managed by the particular runtime environment.

EC8395 - COMMUNICATION ENGINEERING

UNIT I - ANALOG COMMUNICATION

1. Define modulation?

Modulation is a process by which some characteristics of high frequency carrier signal is varied in accordance with the instantaneous value of the modulating signal.

3. What are the types of analog modulation?

Modulation is of two types:

Amplitude modulation & Angle Modulation

4. Define depth of modulation or Modulation index of AM.

(or)

State the significance of modulation index (MAY/JUNE 2014)

It is defined as the ratio between message amplitude to that of carrier amplitude. m=Em/Ec. It is also known as co efficient of modulation

4. What are the degrees of modulation?

- Under modulation. m<1
- Critical modulation m=1
- Over modulation m>1

5. What is the need for modulation? Needs for modulation is as follows:

- Ease of transmission Multiplexing
- Reduced noise
- Narrow bandwidth
- Frequency assignment
- Reduce the equipment limitations.
- Reduce antenna height.

6. What are the types of AM modulators?

There are two types of AM modulators. They are

1) Linear modulators

2) Non-linear modulators

Linear modulators are classified as Transistor modulator and Switching modulators.
There are three types of transistor modulator.

a) Collector modulator b) Emitter modulator c) Base modulator Non-linear modulators are classified as Square law modulator Product modulator and Balanced modulator.

7. Give the classification of modulation.

There are two types of modulation. They are Analog modulation Digital modulation Analog modulation is classified into Continuous wave modulation and Pulse modulation

Continuous wave modulation is classified as follows

Amplitude modulation and Phase modulation

There are 3 types of amplitude modulation:

1. Double side band suppressed carrier 2. Single side band suppressed carrier 3. Vestigial side band suppressed carrier

Angle modulation is further classified as

1. Frequency modulation 2. Phase modulation Pulse modulation is classified as follows

1. Pulse amplitude modulation
2. Pulse position modulation
3. Pulse duration modulation

4. Pulse code modulation

Digital modulation is classified as follows

Amplitude shift keying, Phase shift keying, Frequency shift keying.

8. What is single tone and multi tone modulation?

If modulation is performed for a message signal with more than one frequency component then the modulation is called multi tone modulation.

If modulation is performed for a message signal with one frequency component then the modulation is called single tone modulation.

9. What are the advantages of VSB-AM?

1. It has bandwidth greater than SSB but less than DSB system. 2. Power transmission greater than DSB but less than SSB system. 3. No low frequency component lost. Hence it avoids phase distortion.

10. Define demodulation.

Demodulation or detection is the process by which modulating voltage is recovered from the modulated signal. It is the reverse process of modulation.

11. Define multiplexing.

Multiplexing is defined as the process of transmitting several message signals simultaneously over a single channel.

12. What is meant by frequency translation?

The process of translating incoming carrier frequency into upward and down ward frequency is called as frequency translation. It can be either up conversion or down conversion.

13. What are advantages and disadvantages of SSB?

Advantages: Saving power, Reduce BW by 50%, Increase efficiency & increased SNR

Disadvantages: Complex circuits for frequency stability

14. What are the applications of SSB-SC-AM?

- SSB telegraph system
- Aircraft
- Radio telephone
- VHF and UHF communication system.

15. **What is the difference between high level modulation and lowl vel modulation?**

Low level AM modulator	High level AM modulator
1. Modulation takes place prior to the final stage of the transmitter	1. Modulation takes place in the final element of final stage.
2. Less modulating signal power is required	2. More modulating signal power is required.

16. What is diagonal clipping and how can we eliminate it and peak negative clipping?

This type of distortion occurs when the constant of the RC load is too large. At high modulation depths, the current changes so fast the time constant of the load does not follow the Changes. As a result the current will decay exponentially instead of following the wave form. Diagonal clipping can be eliminated by choosing a proper value of time constant

Choose $RC \square \sqrt{\frac{1 \square m^2}{w_m R_a}}$

Peak negative clipping can be eliminated by keeping AC and DC load resistance equal and the modulation index of modulated signal and detector should be same.

17. Define Amplitude modulation.

The amplitude of the high frequency carrier signal is varied in accordance with the instantaneous value of the message signal.

18. What is over modulation and Envelope distortion?

If modulation index of an AM is greater than 1, the envelope does not preserve the side bands rather the base band signal recovered from the envelope is distorted.

19. Define frequency modulation. (MAY/JUNE 2014)

Frequency modulation is defined as the process by which the frequency of the carrier wave is varied in accordance with the **instantaneous amplitude of the modulating or message signal.**

20. Define modulation index of frequency modulation. (MAY/JUNE 2015)

It is defined as the ratio of maximum frequency deviation to the modulating frequency. $\beta = \delta f/fm$

21. Define phase modulation. (MAY/JUNE 2014)

Phase modulation is defined as the process of changing the phase of the carrier signal in accordance ith the instantaneous amplitude of the message signal.

22. What is meant by detection? Name the methods for detecting FM?

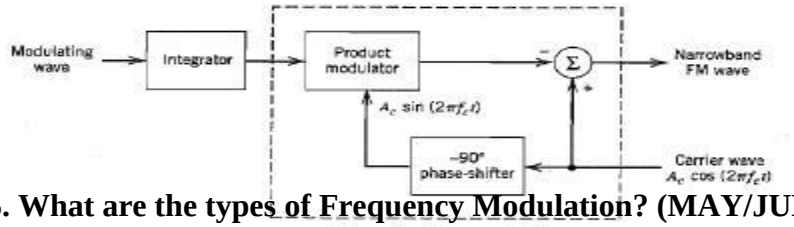
Detection is the process of getting back the original message signal from the received modulated signal. The various methods for detecting FM are as follows

1. Balanced discriminator.
2. Phase discriminator
3. Ratio detector
4. PLL demodulator

23. What are the advantages of Ratio detector?

The main advantage of using Ratio detector is that there is no need for separate amplitude limiting circuitry.

24. Draw the block diagram of a method for generating a narrow band FM.



Block diagram of a method for generating a narrowband FM signal.

25. What are the types of Frequency Modulation? (MAY/JUNE 2015)

Based on the modulation index FM can be divided into types. They are Narrow band FM and Wide band FM. If the modulation index is greater than one then it is wide band FM and if the modulation index is less than one then it is Narrow band FM.

26. What is the basic difference between an AM signal and a narrowband FM signal? In The case of sinusoidal modulation, the basic difference between an AM signal

and a narrowband FM signal is that the algebraic sign of the lower side frequency in the narrow band FM is reversed.

27. What are the two methods of producing an FM wave?

Basically there are two methods of producing an FM wave. They are,

i) Direct method

In this method the transmitter originates a wave whose frequency varies as function of the modulating source. It is used for the generation of NBFM

ii) Indirect method

In this method the transmitter originates a wave whose phase is a function of the modulation. Normally it is used for the generation of WBFM where WBFM is generated from NBFM

FM Modulators: There are 2 types of FM modulators.

1. Direct Method

2. Indirect Method

28. List the properties of the Bessel function. (MAY/JUNE 2015) The properties of the Bessel function is given by,

i) $J_n(\beta)=(-1)^n J_{-n}(\beta)$ for all n, both positive and negative.

ii) For small values of the modulation index β ,we have $J_0(\beta)=1$

$J_1(\beta)=\beta/2$

$J_n(\beta)=0, n>2.$

iii) $\sum_{n=-\infty}^{\infty} J^2_n(\beta)=1$

29. Give the average power of an FM signal.

The amplitude of the frequency modulated signal is constant .The power of the FM sig al is same as that of the carrier power. $P=1/2\ E_c^2$.

30. State the Carson's rule. (Nov/DEC 2015)

An approximate rule for the transmission bandwidth of an FM Signal generated by a single tone-modulating signal of frequency f_m is defined as

$$BW = 2(\Delta f + f_m)$$

Where Δf is the frequency deviation.

31. Define the deviation ratio D for non-sinusoidal modulation.

The deviation ratio D is defined as the ratio of the frequency deviation f, which corresponds to the maximum possible amplitude of the modulation signal m(t),to the highest modulation frequency .

$D = f / f_m$

32. What are the disadvantages of FM system?

1. A much wider channel is required by FM.

2. FM transmitting and receiving equipments tend to be more complex and hence it is expensive .

33. What are the types of FM detectors?

Slope detector and phase discriminator**.**

34. What are the types of phase discriminator? (Nov/DEC 2015)

Foster-seely discriminator and ratio detector.

35. What are the disadvantages of balanced slope detector?

Amplitude limiting cannot be provided

Linearity is not sufficient

It is difficult to align because of three different frequencies to which various tuned circuits to be tuned.

The tuned circuit is not purely band limited.

36. Define frequency Deviation.

The maximum change in instantaneous frequency from the average is known as frequency deviation

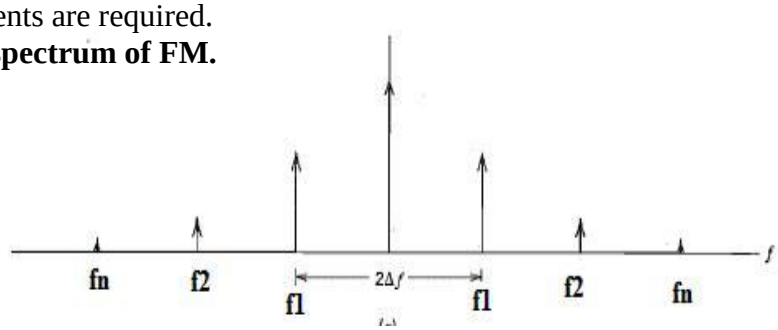
37. Define Phase deviation.

The maximum phase deviation of the total angle from the carrier angle is called phase deviation $K_f E_m$

38.Give the merits of ratio detector.

It gives excellent noise free output It does not require limiter
Relatively fewer components are required.

39.Draw the frequency spectrum of FM.



40. Define sensitivity of a receiver.

It is defined as a measure of its ability to receive weak signals.

41. Define selectivity of a receiver.

Selectivity of a receiver is defined as its ability to select the desired signals among the various signals.

42. Define stability.

It is the ability of the receiver to deliver a constant amount of output for a given a given period of time.

43. Define super heterodyne principle.

It can be defined as the process of operation of modulated waves to obtain similarly modulated waves of different frequency. This process uses a locally generated carrier wave, which determines the change of frequency.

44. What is TRF receiver?

Tuned Radio Frequency is also called straight receiver. Here the receiver operates in straight forward manner without frequency conversion.

45. What are the advantages of super heterodyne receiver over TRF? (Nov/DEC 2015)

The advantages of super heterodyne receiver over TRF are high selectivity, improved sensitivity throughout the carrier frequency band. It eliminates image frequency.

46. What is the figure of merit of DSBSC system ? The
figure of merit of DSBSC signal is unity

47. What is Capture effect? (MAY/JUNE 2015)

When the interference signal and FM input are of equal strength, the receiver fluctuates back and froth between them .This phenomenon is known as the capture effect.

48. What is threshold effect?

As the input noise power is increased the carrier to noise ratio is decreased the receiver breaks and as the carrier to noise ratio is reduced further crackling sound is heard and the output SNR cannot be predicted by the equation. This phenomenon is known as threshold effect.

49. What is Pre-emphasis?

The premodulation filtering in the transistor, to raise the power spectral density of the base band signal in its upper-frequency range is called pre emphasis (or pre distortion**)**

Pre emphasis is particularly effective in FM systems which are used for transmission of audio signals.

50. Define de-emphasis.

The filtering at the receiver to undo the signal pre-emphasis and to suppress noise is called de-emphasis.

51. What do you infer from the receiver output of a coherent detector?

The output equation $y(t)=1/2Cacm(t) +1/2n_I(t)$ indicates that the message signal and in-phase noise component of the filtered noise appear additively at the receiver output. The quadrature component of the narrow band noise is completely rejected by the coherent detector.

52. What is the figure of merit of a AM system with 100 percent modulation?

The figure of merit of a AM system with 100 percent modulation is 1/3.This means that other factors being equal an AM system must transmit three times as much average power as a suppressed system in order to achieve the same quality of noise performance**.**

53. What is called image frequency?

Image frequency is defined as the signal frequency plus twice the intermediate frequency. This has the effect of two stations being received simultaneously and hence it is undesirable.

$$f_{si} = f_s + 2 f_i$$

f_{si} - image frequency

It can be eliminated by providing adequate image signal selectivity between antenna and mixer input.

54. What is intermediate frequency?

Intermediate frequency (IF) is defined as the difference between the signal frequency and the oscillator frequency**.**

$$\mathbf{IF = f_s - f_o \qquad when\ f_s > f_o}$$

$$\mathbf{IF = f_o - f_s \qquad when\ f_o > f_s}$$

55. What are the characteristics of a receiver?

The characteristics of a receiver are sensitivity, selectivity, fidelity, and signal to noise ratio.

56. What is the function of amplitude limiter in FM system?

The function of amplitude limiter in FM system is used to remove the amplitude variations by clipping the modulated wave at the filter output almost to the zero axis .The resultant wave is rounded off by another BPF that is an integral part of the limiter thereby suppressing the harmonics of the carrier frequency.

57. What are the advantages of Super heterodyne receiver? (MAY/JUNE 2015)

- Improved selectivity and sensitivity.
- High stability.
- Uniform BW.
- No tuning noise problems

58. Compare AM DSBFC with DSB-SC and SSB-SC.

AM DSBFC	DSB-SC	SSB-SC
Bandwidth=$2f_m$	Bandwidth=$2f_m$	Bandwidth=f_m
Contains USB, LSB, carrier	Contains USB,LSB	Contains LSB or USB
More power is required for transmission	Power required is less than that of AM	Pow r r qui ed is less than AM & DSB-SC

59. Compare linear and non-linear modulators.

Linear modulators	Non-linear modulators
1.Heavy filtering is not required	1.Heavy filtering is required
2.These modulators are used in high level modulation	2.These modulators are used in low level modulation

60. How will you generating DSBSC-AM?

There are two ways of generating DSBSC-AM such as

1. balanced modulator 2.ring modulators

61. Why VSB is preferred for TV transmission? (NOV/DEC 2014)

VSB is preferred for TV transmission because of reduced BW of modulation system

62. Draw the frequency spectrum of AM wave.

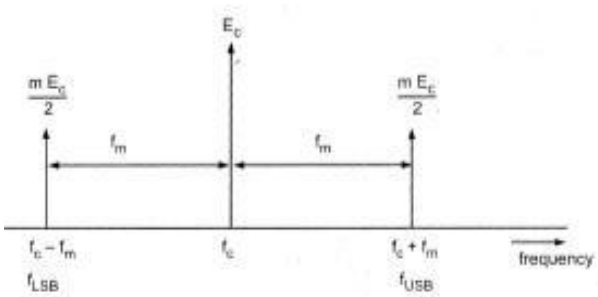
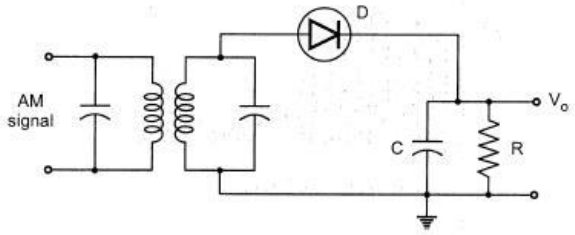
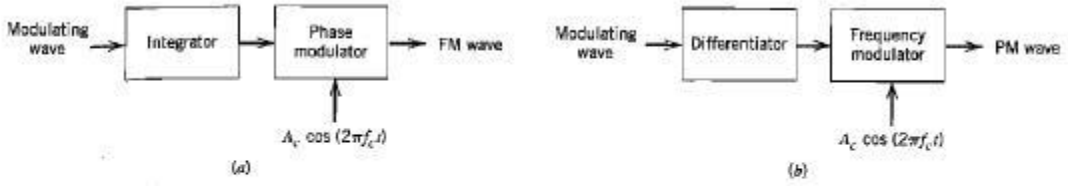


Fig 2 Frequency domain representation of AM wave

63. Sketch the basic envelope detector.



64. Illustrate the relationship between FM and PM with block diagrams. 0r How PM wave can be converted to FM wave?



Ilustration of the relationship between FM and PM
Fig (a) Generation of FM using PM
Fig (b) Generation of PM from FM

65 . How is the narrow band FM converted to Wide band FM?

Wide band Fm can be generated from Narrow band FM by passing the out put of Narrow band FM through stages of multipliers.

66. Distinguish between Narrow band FM and Wide Band FM.

S.No	Narrow band FM	Wide band FM
1	Modulation index is < 1	Modulation index > 10
2	$s(t) = A_c \cos(2\pi f_c t) - mA_c \sin(2\pi f_c t)\sin(2\pi f_m t)$	$s(t) = A_c \sum_{n=-\infty}^{\infty} J_n(m)\cos[2\pi(f_c + nf_m)t]$
3	Spectrum contains 2 sidebands and carrier	Spectrum cont6ains infinite number of sidebands and carrier
4	BW=2fm	$BW = 2(\delta + f_m(\max))$
5	It is used for mobile communication	It is used for broadcasting and entertainment
6	Maximum deviation =75Hz	Maximum deviation = 5 Hz
7	Range of modulating frequency 30Hz to 15 Kz	Range of modulating frequency 30Hz to 3 Kz

67. How will you generate message from frequency-modulated signals?

First the frequency-modulated signals are converted into corresponding amplitude-modulated signal using frequency dependent circuits. Then the original signal is recovered from this AM signal

68.Compare the noise performance of an AM and FM system?

The figure of merit of AM system is 1/3 when the modulation is 100 percent and that of FM is$(3/2)mf^2$.

The use of FM offers improved noise performance over AM when $(3/2)mf^2 > 1/3.mf$ –modulation index in FM.

69. How is threshold reduction is achieved in FM system? (Nov/DEC 2015)

Threshold reduction is achieved in FM system by using an FM demodulator with negative feedback or by using a phase locked loop demodulator.

70. Compare the noise perform nce of AM receiver with that of DSB-SC receiver.

The figure of merit of DSB-SC or SSB-SC receiver using coherent detection is always unity, The figure of merit of AM receiver u ing envelope detection is always less than unity. Therefore noise performance of AM receiver is always inferior to that of DSB-SC due to the wastage of power for transmitting the carrier.

72. **.The antenna current of an AM transmitter is 8A when only carrier is sent. It increases to 8.93A when the carrier is modulated by a single sine wave. Find the p rcentage modulation.**

<u>Solution:</u> Given Ic=8A , It-8.93A and m=0.8

$$I_t=I_c\ (1+m^2/2)^{½}$$

$$8.93=8(1+m^2/2)^{½}$$

$$8.93=8(1+m^2/2)^{½}$$

73. How many AM broadcast station can be accommodated in a 100KHz bandwidth if the highest frequency modulating a carrier is 5KHz?

Total BW given is 100 KHz: fm=5KHZ BW
of AM is equal to 2fm=10 KHz
Number of stations accommodated = Total BW/ BW per station = 10 stations.

74. A transmitter supplies 8 Kw to the antenna when modulated. Determine the total power radiated when modulated to 30%.

$$m=0.3;P_c=8kw^2$$

75 .The antenna current of an AM transmitter is 8A when only carrier is sent. It increases to

8.93A when the carrier is modulated by a single sine wave. Find the percentage modulation.

<u>Solution:</u> Given Ic=8A , It-8.93A and m=0.8

$$I_t=I_c\ (1+m^2/2)^{½}$$

$$8.93=8(1+m^2/2)^{½}$$

8.93=8(1+m /2)

76. How many AM broadcast station can be accommodated in a 100KHz bandwidth if the highest frequency modulating a carrier is 5KHz?

Total BW given is 100 KHz: fm=5KHZ BW of
AM is equal to 2fm=10 KHz
Number of stations accommodated = Total BW/ BW per station = 10 stations.

77. A transmitter supplies 8 Kw to the antenna when modulated. Determine the total power radiated hen modulated to 30%.

m=0.3;Pc=8 kw

$Pt=Pc(1+m^2/2)=8.36$ kw

UNIT II - PULSE MODULATION

1. What are the advantages of digital transmission?

- The advantage of digital transmission over analog transmission is noise immunity.
- Digital pulses are less susceptible than analog signals to variations caused by noise.
- Digital signals are better suited to processing and multiplexing than analog signals.
- Digital transmission systems are more noise resistant than the analog transmission systems.
- Digital systems are better suited to evaluate error performance.

2. What are the disadvantages of digital transmission?

- The transmission of digitally encoded analog signals requires significantly more bandwidth than simply transmitting the original analog signal.
- Analog signal must be converted to digital codes prior to transmission and converted back to analog form at the receiver, thus necessitating additional encoding and decoding circuitry.

3. Define pulse code modulation.

In pulse code modulation, analog signal is sampled and converted to fixed length, serial binary number for transmission. The binary number varies according to the amplitude of the analog signal.

4. What is the purpose of the sample and hold circuit?

The sample and hold circuit periodically samples the analog input signal and converts those samples to a multilevel PAM signal.

5. What is the Nyquist sampling rate?

Nyquist sampling rate states that, the minimum sampling rate is equal to twice the highest audio input frequency.

6. Define and state the causes of fold over distortion.

The minimum sampling rate(fs) is equal to twice the highest audio input frequency(fa).If fs is less than two times fa ,distortion will result. The distortion is Called aliasing or fold over distortion. The side

frequencies from one harmonic fold over into the sideband of another harmonic. The frequency that folds over is an alias of the input signal hence, the names “aliasing” or “fold over distortion”.

7. Define overload distortion.

If the magnitude of sample exceeds the highest quantization interval, overload distortion occurs.

8. Define quantization (Nov/DEC 2015)

Quantization is a process of approximation or rounding off. Assigning PCM codes to absolute magnitudes is called quantizing.

9. Define dynamic range.

Dynamic range is the ratio of the largest possible magnitude to the smallest possible magnitude. Mathematically, dynamic range is DR= (Vmax) /(Vmi)

10. Define coding efficiency. (May/June 2015)

Coding efficiency is the ratio of the minimum number of bits required to achieve

a certain dynamic range to the actual number of PCM bits used. Mathematically, coding efficiency is

Coding efficiency= Minimum number of bits (including sign bit) X 100 Actual number of bits

(including sign bit)

11. Define Companding.

Companding is the process of compressing, then expanding. With companded systems, the higher amplitude analog signals are compressed prior to transmission, then expanded at the receiver.

12. Define slope overload. How it is reduced. (May/June 2015)

The slope of the analog signal is greater than the delta modulator can maintain, and is called slope overload. Slope overload is reduced by increasing the clock frequency and by increasing the magnitude of the minimum step size.

13. Define granular noise. How it is reduced? (Nov/DEC 2015)

When the original input signal has relatively constant amplitude, the reconstructed signal has variations that were not present in the original signal. This is called granular noise. Granular noise can be reduced by decreasing the step size.

14. Define adaptive delta modulation.

Adaptive delta modulation is a delta modulation system where the step size of the AC is automatically varied depending on the amplitude characteristics of the analog input signal.

15. Define peak frequency deviation for FSK.

Peak frequency deviation (_f) is the difference between the carrier rest frequency and either the mark or space frequency and either the mark or space frequency. (Δf)=|fm-fs|/2

16. Define modulation index for FSK.
The modulation index in FSK is defined as h = (Δf)/ fa

Where h= FM modulation index called the h factor in FSK fa = fundamental frequency of the binary modulating signal (Δf) = Peak frequency deviation (hertz)

1**7. Define bit rate.**

In digital modulation, the rate of change at the input to the modulator is called the bit rate (fb) and has the unit of bits per second (bps).

18. Define Baud rate.
The rate of change at the output of the modulator is called baud.

19. Define QAM.

Quadrature amplitude modulation is a form of digital modulation where the digital information is contained in both the amplitude and phase of the transmitted carrier.

20. Write the relationship between the minimum bandwidth required for an FSK system and the bit rate.
The minimum bandwidth can be approximated as B=2Δf +2fb

Where B=minimum bandwidth (hertz)

Δf=minimum peak frequency deviation (hertz) fb=bit rate

21. What is meant by Digital Amplitude Modulation (DAM)?

The digital amplitude modulation is simply double sideband, full carrier amplitude modulation where the input-modulating signal is a binary waveform.

22. Define FSK bite rate & baud.
The rate of change at the input to the modulator is called the bit rate (¦b) and has the unit of bits per second.

The rate of change at the output of the modulator is called baud.

23. What is meant by Frequency Shift Keying (FSK)?

Frequency Shift Keying is the relatively simple, low performance type of digital modulation
Binary FSK is a form of constant amplitude angle modulation similar to conventional frequency modulation except that he modulating signal is a binary signal that varies between two discrete voltage levels rather than a continuously changing analog waveform.

24. What do you meant by M-ary encoding?

M-ary is a term derived from the word binary. M is simply a digit that represents the number of conditions or combinations possible for a given number of binary variables.

25. What does QPSK mean? (NOV/DEC 2014)

Quaternary Phase Shift Keying (QPSK), or quadrature PSK as it is sometimes called, is another form of angle modulated, constant amplitude digital modulation. QPSK is an M-ary encoding technique where M=4.

27. What is meant by offset QPSK?

Offset QPSK is a modified form of QPSK where the bit waveforms on the I and Q channels are offset or shifted in phase from each other by one half a bit time.

28. What does QAM stands for?

Quadrature amplitude Modulation (QAM) is a form of digital modulation where the digital information is contained in both the amplitude and phase of the transmitted carrier.

29. Define Bandwidth efficiency.

It is defined as the ratio of the transmission bit rate to the minimum bandwidth required for a particular modulation scheme.

BW efficiency = transmission rate (bps) / minimum BW (Hz) bits/cycle

30. Define carrier recovery & what are all the methods used for this?

Carrier recovery is the process of extracting a phase coherent reference carrier from a receiver signal. This is sometimes called phase referencing. Methods are squaring loop, costas loop, or re modulator.

31. What is meant by DPSK?

Differential Phase Shift Keying (DPSK) is an alternative form of digital modulation where the binary input information is contained in the difference between two successive signaling elements rather than the absolute phase.

32. What is meant by Probability of error & Bit Error Rate?

Probability of error P (e) & Bit Error Rate (BER) are often used interchangeably, although in practice they do have slightly different meanings. P(e) is a theoretical expectation of the bit error rate for a given system. BER is an empirical record of a systems actual bit error performance.

33. What is meant by antipodal signaling?

The phase relationship between signaling elements for BPSK (i.e., 180 degree out of phase) is the optimum-signaling format, referred to as antipodal signaling, and occurs only when two binary signal levels are allowed and when one signal is the exact negative of the other.

34. **Give the formula for the error distance of the PSK.** The error distance of the PSK is given by,

d = (2 sin 180/M)*D Where,

d – error distance M – number of phases D – peak signal amplitude

35. What does 8-QAM & 16-QAM means?

Eight QAM is an M-ary encoding technique where M=8. The output signal from an 8-QAM is not constant amplitude. Sixteen QAM is also an M-ary system where M=16.

36. What are all the types of FSK systems & explain them? There are two types of FSK system.

Non coherent FSK Coherent FSK

With non-coherent FSK, the transmitter and receiver are not frequency or phase synchronized.

With coherent FSK, local receiver reference signals are in frequency and phase lock with the transmitted signals.

38. What is meant by peak frequency deviation?

Peak frequency deviation is the product of the binary input voltage and the deviation sensitivity of the VCO.
$\Delta f = Vm(t) * kL$ Where,

Δf = Peak frequency deviation (Hz)
vm(t)= peak binary modulating signal voltage (volts)

kL = deviation sensitivity (Hz per volt)

39. What is meant by pulse modulation & name the methods of it?

Pulse modulation includes many different methods of converting information into pulse form for transferring pulses from a source to a destination.
Methods:

Pulse Width Modulation

Pulse Position Modulation
Pulse Amplitude Modulation

Pulse code Modulation

40. Define Pulse Width Modulation (PWM).

The pulse width (active portion of the duty cycle) is proportional to the amplitude of the analog signal. This method is sometimes called as pulse duration modulation (PDM) or pulse length modulation (PLM).

41. Define Pulse Position Modulation (PPM) & Pulse Amplitude Modulation (PAM).

The position of a constant width pulse within a prescribed time slot is varied according to the amplitude of the analog signal is called PPM. The amplitude of a constant width, constant position pulse is varied according to the amplitude of the analog signal.

42. What is meant by Codec? (May/June 2015)

An integrated circuit that performs the PCM encoding and decoding functions is called a codec (coder/decoder).

43. What are all the two basic techniques used to perform the sample and hold Function?

There are two basic techniques used to perform the sample and hold function and they are given by, Natural sampling & Flat top sampling.

45. Define the term synchronous transmission.

In the synchronous transmission, the transmitter and receiver both operate at common clock signal. The data is transmitted as a block. There are no start and stop bits. Tim ng errors are minimum in synchronous mode.

49. What is meant by Adaptive Delta Modulation in PCM?
Adaptive delta modulation is the delta modulation system where the step size of the Digital to Analog Converter (DAC) is automatically varied depending on the amplitude characteristics of the analog input signal.

50. Give the formula for percentage error of PCM. The percentage error is given by,

%Error = |Transmit voltage – Receive voltage| / Receive voltage*100

51. What is meant by Inter Symbol Interference (ISI)?

At the sampling instants (i.e., the center of the pulses), the signal does not always attain the maximum value. The tails of several pulses have overlapped, thus interfering with the major pulse lobe. This interference is called inter symbol interference.

52. State Sampling theorem. (May-June 2014)

A band-limited signal of finite energy, which has no frequency components higher than W Hz, may be completely recovered from the knowledge of its samples taken at the rate of 2W samples per second.

<u>UNDERSTAND</u>

53. Compare Amplitude Shift Keying (ASK) & Frequency Shift Keying (FSK)? (MAY-JUNE 2014)
ASK

1. Amplitude of the signal is modulated as per digital data
2. Minimum BW = 2fb

3. Transmitted power keeps on changing

FSK

1. Frequency of the signal is modulated as per digital data

2. Minimum BW = 4fb

3. Transmitted power remains constant

54. Compare the bandwidth efficiency of BPSK and QPSK modulated signals.
The bandwidth efficiency of BPSK is 1 bit per cycle, where as that of QPSK is 2 bits per cycle
The bandwidth efficiency of QPSK is more because it encodes the signal with 4 different phase shifts.

Therefore it combines two successive bits.

55. Explain how eye pattern is used to measure ISI in pulse transmission. From the interpretation of eye pattern the following measures can be obtained, Best sampling time of the signal

Height of eye opening gives margin over noise

Slope of eye opening gives sensitivity to timing error.

UNIT – III - DIGITAL MODULATION AND TRANSMISSION

1. Define lossless channel.

The channel described by a channel matrix with only one nonzero element in each column is called a lossless channel. In the lossless channel no sources information is lost in transmission**.**

2. Define Deterministic channel

A channel described by a channel matrix with only one nonzero element in each row is called a deterministic channel and this element must be unity.

3. Define noiseless channel.

A channel is called noiseless if it is both lossless and deterministic. The channel matrix has only one element in each row and in each column and this element is unity. The input and output alphabets are of the same size.

4. What are the types of Correlation?
The types of Correlation are Cross Correlation and Auto Correlation

5. What is the difference between Correlation and Convolution?
In Correlation physical time „t‟ is dummy variable and it disappears after solution of an integral.
But in convolution „ι‟ is a dummy variable.

Convolution is a function of delay parameter „t„ but convolution is a function of„ t‟.
Convolution is commutative but correlation is noncom mutative**.**

6. What is digital Modulation?
DM stands for **Digital Modulation** and is a generic name for **modulation** techniques that uses discrete signals to modulate a carrier wave. In comparison, FM and AM are analog techniques. The three main types

of **digital modulation** are Frequency Shift Keying (FSK), Phase Shift Keying (PSK) and Amplitude Shift Keying (ASK).

7. Define Signal.

A signal is defined as any physical quantity carrying information that varies with time. The value of signal may be real or complex. The types of signal are continuous signal and discrete time signal.

8. State Shannon's capacity theorem for a power and band limited channel.

The information capacity of a continuous channel of BW B Hz perturbed by a AWGN of PSD No/2 and limited to BW B is given by $C=\log_2[1+(P/NoB)]$ .where P is the average transmitted power

9. Define entropy. (May/June 2015)

Entropy is the measure of the average information content per second. It is given by the expression $H(X)=\sum_I P(xi)\log_2 P(xi)$ bits/sample.

10. Define mutual information.

Mutual information I(X,Y) of a channel is defined by I(X,Y)=H(X)-H(X/Y) bits/symbol

H(X)- entropy of the source H(X/Y)- conditional entropy of Y.

11. State the properties of mutual information.

1. I(X,Y)=I(Y,X)
2. I(X,Y)>=0
3. I(X,Y)=H(Y)-H(Y/X)
4. I(X,Y)=H(X)+H(Y)-H(X,Y).

12. Give the relation between the different entropies.

H(X,Y)=H(X)+H(Y/X)

=H(Y)+H(X/Y)

H(X)- entropy of the source(Y/X),H(X/Y)-conditional entropy H(Y)-entropy of destination

H(X,Y)- Joint entropy of the source and destination **13. Define information rate.**

If the time rate at which source X emits symbols is r symbols per second. The information rate R of the source is given by

R=r H(X) bits/second H(X)- entropy of the source

14. What is data compaction?

For efficient signal transmission the redundant information must be removed from the signal prior to transmission .This information with no loss of information is ordinarily performed on a signal in digital form and is referred to as data compaction or lossless data compression.

15. State the property of entropy. (May/June 2015)

1. $\text{Log}M \geq H(x) \geq 0$

2. $H(X) = 0$ if all probabilities are zero
3. $H(X) = \log_2 M$ if all probabilities are equal

16. What is differential entropy?

The average amount of information per sample value of x(t) is measured by

$H(X) = -\int_{-\infty}^{\infty} f_x(x) \log f_x(x) dx$ bit/sample H(X) –differential entropy of X.

17. What is the channel capacity of a discrete signal?

The channel capacity of a discrete signal C= max I(X,Y) P(xi)
I(X, Y)-mutual information.

18. What is source coding and entropy coding?

A conversion of the output of a DMS into a sequence of binary symbols is called source coding. The design of a variable length code such that its average cod word length approaches the entropy of the DMS is often referred to as entropy coding.

19. State Shannon Hartley theorem.

The capacity „C" of a additive Gaussian noise channel is $C=B \log_2 (1+S/N)$ B= channel bandwidth, S/N=signal to noise ratio.

20. What is the entropy of a binary memory-less source?

The entropy of a binary memory-less source
$H(X)=-p_0 \log_2 p_0-(1-p_0)\log_2(1-p_0)$
p_0 probability of symbol „0",
$p1=(1- p_0)$ =probability of transmitting symbol „1".

21. What happens when the number of coding alphabet increases?

Since the number of coding alphabet increases the efficiency of the coding technique decreases.

22. What is information theory?

Information theory deals with the mathematical modeling and analysis of a communication system rather than with physical sources and physical channels

23. What is the channel capacity of a BSC and BEC?

For BSC the channel capacity C=1+plog2 p +(1-p)log2(1-p). For BEC the channel capacity C=(1-p)4)

24. List the properties of Hamming distance. (NOV/DEC 2014)

The Hamming distance is a metric on the set of the words of length n (also known as a Hamming space), as it fulfills the conditions of non-negativity, identity of indiscernibles and symmetry, and it can be shown by complete induction that it satisfies the triangle inequality as well.

25. What are the popular coding sequences of CDMA system? (NOV/DEC 2014)

Popular code sequences used in spread-spectrum transmission are

- -Maximum Length sequences
- -Walsh Hadamard sequences
- -Gold codes, and
- -Kasami codes.

26. Explain Shannon-Fano coding. (May/June 2015)

An efficient code can be obtained by the following simple procedure, known as Shannon- Fano algorthim.

1. List the source symbols in order of decreasing probability.

Partition the set into two sets that are as close to equiprobable as possible, and sign 0 to the upper set and 1 to the lower set.

Continue this process, each time partitioning the sets with as nearly equal probabilities as possible until further partitioning is not possible.

UNIT IV - INFORMATION THEORY AND CODING

1. What is hamming distance?

The hamming .distance .between .two code vectors .is equal to the number .of elements in which they differ. For example, let the two code words be, X = (101) and Y= (110)

These .two .code .words .differ .in .second .and .third .bits. .Therefore .the .hamming distance between X and Y is two.

2. Define code efficiency.

The code efficiency is the ratio of message bits in a block to the transmitted bits for that block by the encoder i.e., Code efficiency= (k/n) k=message bits n=transmitted bits.

3. What is meant by systematic and non-systematic codes?

In a Systematic block code, message bits appear first and then check bits. In the non-systematic code, message and check bits cannot be identified in the code vector.

4. What is meant by linear code?

A code is linear if modulo-2 sum of any two code vectors produces another code vector. This means any code vector can be expressed as linear combination of other code vectors.

5. What are the error detection and correction capabilities of hamming codes?

The minimum distance (dmin) of hamming codes is „3‟ . .Hence it can be used to detect double errors or correct single errors. Hamming codes are basically linear block codes with dmin =3.

6. What is meant by cyclic codes?

Cyclic codes are the subclasses of linear block codes. They have the property that a cyclic shift of one codeword produces another code word.

7. How syndrome is calculated in Hamming codes and cyclic codes?

In hamming codes the syndrome is calculated as, S=YH.T

Here Y is the received and H is the transpose of parity check matrix

8. What is BCH code?

BCH codes are most extensive and powerful error correcting cyclic codes .The decoding of BCH

codes is comparatively simpler. For any positive integer „m‟ and „t‟ (where t<2 m-1) there exists a BCH code with following parameters:

Block length: n= 2 m-1

Number of parity check bits : n-k<=mt

Minimum distance: d min>=2t+1

9. What is RS code?

These are non binary BCH codes. The encoder for RS code operates on multiple bits

simultaneously. The (n, k) RS code takes the groups of m- bit symbols of incoming binary data stream. It takes such „k‟ number of symbols in one block.

Then the encoder acts (n – k) redundant symbols to form the code word of „n‟ symbols

RS code has:

Block Length : n=2.-1msymbols

Message size: K symbols

Parity check size: n-k= 2t symbols

Minimum distance: dmin=2t+a symbols

10. What is difference between block codes and convolutional codes?

Block codes takes‟ k‟ .number of bits simultaneously form „n‟ -bit .code vector. This code vector is also called block. Convolutional code takes one message bits at a time and generates two or more encoded bits. Thus convolutional codes generate a string of encoded bits for input message string.

11. Define constraint length in convolutional code?

Constraint length is the number of shift over which the single message bit can influence the encoder output. It is expressed in terms of message bits.

12. Define free distance and coding gain.

Free distance is the minimum distance between code vectors. It is also equal to minimum weight of the code vectors.
Coding gain is used as a basis of comparison for different coding methods. To achieve the same bit error

rate the coding gain is defined as,

A= (E.b/N.) Encoded (E.b/N.) encoded

For convolutional coding, the coding gain is given as, A =
rd./f2

Here „r‟ is the code rate

And „df is the free distance.

13. What is convolution code?

Fixed number of input bits is stored in the shift register & they are combined with the help of mod 2 adders. This operation is equivalent to binary convolution coding.

14. What is meant by syndrome of linear block code?

The non zero output of the produce YHT is called syndrome & it is used to detect errors in y. Syndrome is denoted by S & given as,

S=YH T

15. What are the advantages of convolutional codes?

Advantages:

The decoding delay is small in convolutional codes since they operate o smaller blocks of data.
The storage hardware required by convolutional decoder is less since the block sizes are smaller.

isadvantages:

Convolutional codes are difficult to analyze since their analysis is complex.

Convolutional codes are not developed much as compared to block codes.

16. Define sates of encoder?

The constraint length of the given convolutional encoder is K=2. Its rate is ½ means for single message bit .input, two bits .x1 and x2 .are encoded at the output. S 1‟ represents the input message bit and S. stores the2 previous message bit. .Since only one previous message bit is stored; .this encoder can have states depending upon this stored message bit.

.Let‟ s represent, S.2= 0

and S.2= 1 state „b‟

state „a‟

17. Compare between code tree and trellis diagram?

Sr. No.	Code tree	Trellis diagram
1	Code tree indicates flow of the coded signal along the nodes of the tree	Trellis diagram indicates transitions from current to next states
2	Code tree is lengthy way of representing coding process	Code trellis diagram is shorter or compact way of representing coding process

18. Write the futures of BCH Codes?

BCH codes are most extensive and powerful error correcting cyclic codes. The decoding of BCH codes is comparatively simpler.

The decoding schemes of BCH codes can be implemented on digital

computer. Because of software implementation of decoding schemes they are quite flexible compared to hardware implementation of other schemes.

19. What is Golay codes?

Golay code is the (23,12) cyclic code whose generating polynomial is, G(p) = p.+1p1.+p.9+p.+7p.+6p+1 5

This code has minimum distance of d min= 7. This code can correct upto 3 errors. But Golay code cannot be generalized to other combinations of n and k.

20. Define constraint length in convolutional codes?

Constraint length is the number of shifts over which the single message bit can influence the encoder output. .This expressed in terms of message bits.

UNIT-V - SPREAD SPECTRUM S AND MULTIPLE ACCESS

1. What is the significance of spread spectrum?

The narrow bandwidth signal is spread over wide band with the help of special code. Hence the name spread spectrum is given.

2. What is the use of special code in spread spectrum?
The special code decides the way in which narrowband signal is spread over wide band.

3. What is key in spread spectrum?

The special code is a pseudo-noi e sequence. It is also called key. Sometimes, the logic for generation of pseudo-noise sequence is called key.

4. What are averaging system and avoidance systems?

In averaging systems, the interference is reduced by averaging it over long period. In avoidance systems making the signal to avoid the interference a large fraction of time reduce the interference.

5. Where spread spectrum is used?
It is used in anti-jam capability; secure communication such as military and ba king purposes.

6. What are the two types of spread spectrum? Direct
sequence spread spectrum

Frequency hop spread spectrum

7. What is the meaning of the word jamming and anti-jam?

In general, the word Jam means to block or resist the flow. A noise is transmitted within the bandwidth of the channel. This noise interferes with the signal, so that the receiver cannot interpret the signal. This is called Jamming. The capability created against jamming is called anti-jam.

8. What is jamming margin?

$$\text{Jamming Margin} = \frac{\text{Average interference power (J)}}{\text{Average signal power (Ps)}}$$

9. What is meant by PN sequence and what are the properties of PN sequence?
The PN sequence is coded sequence of ones and zeros with certain auto-correlation properties.
There are three properties
Balance Property

Run Property
Correlation property

10. Define chip duration and chip rate?

The bit period PN sequence is called chip duration (Tc). Chip rate is the rate at which bits of PN sequence are produced. Chip rate (Rc) =1 / Tc

11. What is the relationship between chip duration and bit duration? Tb = N Tc

Where N is the period of PN sequence Tb is the bit duration Tc is chip duration

12. What is the shape of auto-correlation function of PN sequence?
The shape of auto-correlation function of PN sequence is the triangular shape with period NTc.

13. Define slow frequency hopping. (NOV/DEC 2015)

Several symbols of data are transmitted in one frequency hop. This means symbol rate is higher than hop-rate.

14. **Define FDMA, TDMA and CDMA?** FDMA –
Overall bandwidth is shared. TDMA – Time of
Channel is shared.

CDMA – Time as well as bandwidth is shared.

15. List the important features of TDMA. (NOV/DEC 2014)

- Shares single carrier frequency with multiple users
- Non-continuous transmission makes handoff simpler
- Slots can be assigned on demand in dynamic TDMA
- Less stringent power control than CDMA due to reduced intra cell interference
- Higher synchronization overhead than CDMA
- Advanced equalization may be necessary for high data rates if the channel is "frequency selective" and creates Inter-symbol interference
- Cell breathing (borrowing resources from adjacent cells) is more complicated than in CDMA
- Frequency/slot allocation complexity
- Pulsating power envelop: Interference with other devices

16. What is an FDMA? Explain it.

FDMA is certainly the most conventional method of multiple access and was the first technique to be employed in modern wireless applications. In FDMA, the available bandwidth is split into a number of equal sub-bands, each of which constitutes a physical channel. The channel bandwidth is a function of the services to be provided and of the available technology and is identified by its center frequency, known as a carrier. In single channel per carrier FDMA technology, the channels, once assigned, are used on a non-time-sharing basis. Thus, a channel allocated to a given user remains allocated until the end of task for which the specific assignment was made.

17. What is SDMA? What special features it has when compared to other multiple access techniques? (MAY-JUNE 2014)

SDMA is a nonconventional multiple-access technique that finds application in modern wireless systems mainly in combination with other multiple-access techniques. The spatial dimension has been extensively explored by wireless communications systems in the form of frequency reuse. The deployment of advanced techniques to take further advantage of the spatial dimension is embedded in the SDMA philosophy. In SDMA, the entire bandwidth is made available simultaneously to all signals.

Signals are discriminated spatially using spot beam antennas, and the communication trajectory constitutes the physical channels. (Ex: Spot beam antennas used in IRIDIUM satellites.)

The implementation of SDMA architecture is based strongly on antennas technology coupled with advanced digital signal processing.

As opposed to the conventional applications in which the locations are constantly illuminated by rigid-beam antennas, in SDMA the antennas should provide for the ability to illuminate the locations in a dynamic fashion.

The antenna beams must be electronically and adaptively directed to the user so that, in an idealized situation, the location alone is enough to discriminate the user. FDMA and TDMA systems are usually considered to be narro band, whereas CDMA systems are usually designed to be wideband. SDMA systems are

deployed together in the other multiple-access technologies.

18. What are the pros and cons of CDMA technique?

Pros

Hard to spy, immune from narrow band noise, no need for all stations to synchronize, no hard limit on capacity of a cell &all cells can use all frequencies.

Cons

Implementation complexity, need for power control, to avoid capture need for a large contiguous frequency band (for direct sequence) & problems installing in the field.

19. What is near – far problem? (MAY-JUNE 2014)

The near-far problem is a condition in which a receiver captures a strong signal and thereby makes it impossible for the receiver to detect a weaker signal

20. What are the popular coding sequences of CDMA system? (NOV/DEC 2014) Popular code sequences used in spread-spectrum transmission are

–Maximum_Length_sequences

-Walsh_Hadamard_sequences

-Gold_codes, and

-Kasami codes.

2**1. Explain direct sequence spread spectrum.**

In the first stage, incoming data sequence modulates wideband code. This transforms narrow-band incoming data sequence into wideband signal. The wideband signal digitally modulates carrier.

22. Explain frequency hop spread spectrum. (NOV/DEC 2015)

In this technique, changing the carrier frequency in pseudo-random manner widens the spectrum of data modulated carrier.

23. Why pseudo-random code is used as special code for spreading the spectrum?

Unintended receiver should not receive the signal. If the spreading code is not random, then

Un-intended receiver can obtain the code by observing the signal over certain period of time. But if the code is random, then it is very difficult to identify it.

24. Is spread spectrum a modulation technique?

Sometimes people call spread spectrum modulation. But that does not carry conventional meaning of modulation. Rather it includes conventional digital modulation techniques to generate spread spectrum modulated signals.

25. How many stages of flip-flops are required to generate PN sequence of length 31?
N=2

$31 = 2^m - 1$ m = 5 stages

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V.S.B. ENGINEERING COLLEGE, KARUR
Department of Computer Science and Engineering

Class: II Year / III Semester B.E. Computer Science and Engineering

PART- B & C QUESTIONS

DISCRETE MATHEMATICS
UNIT-I

1. Prove that $(P \to Q) \wedge (Q \to R) \Rightarrow (P \to R)$.
2. Find the PDNF and PCNF of the formula $S \Leftrightarrow (P \to (Q \wedge R)) \wedge (\neg P \to (\neg Q \wedge \neg R))$.
3. Using Conditional proof, prove that $\neg P \vee Q, \neg Q \vee R, R \to S \Rightarrow P \to S$.
4. By using truth table verify whether the following specifications are Consistent. Whenever the system software is being upgraded users cannot access the file system. If users can access file system , then they can save new files. If users cannot save new files then the system software is not being upgraded.
5. Without using truth tables, show that $\neg P \wedge (\neg Q \wedge R) \vee (Q \wedge R) \vee (P \wedge R) \Leftrightarrow R$.
6. Obtain PDNF & PCNF of $(\neg P \to R) \wedge (Q \leftrightarrow P)$.
7. Show that S is a valid inference from the premises $P \to \neg Q, Q \vee R, \neg S \to P \,\&\, \neg R$.
8. Without using truth tables , show that $\neg P \wedge (\neg Q \wedge R) \vee (Q \wedge R) \vee (P \wedge R) \Leftrightarrow R$.
9. Obtain PDNF & PCNF of $(\neg P \to R) \wedge (Q \leftrightarrow P)$
10. Show that $R \to S$ is a valid inference from the set of premises $P \to (Q \to S), \neg R \vee P \,\&\, Q$.
11. Show that the following premises are inconsistent:
    1. If Jack misses many classes through illness and reads a lot of books.
    2. If Jack fails high school, then he is uneducated.
    3. If Jack reads a lot of books, then he is not uneducated.
    4. Jack misses many classes through illness and reads a lot of book.
12. "If there was a ball game , then traveling was difficult. If arrived on time, then travelling was difficult. If they arrived on time, then traveling was not difficult. They arrived on time. Therefore there was no ball game". Show that these statements constitute a valid argument.
13. Show the validity of the argument:
    If the band could not play rock music (or) the refreshments were not delivered on time, then the new year's party would have been cancelled and Alice would have angry.If the party were cancelled, then refunds would have to be made. No refunds were made. Therefore the band could play rock music.

14. Establish the validity of the argument.
$U \to R, (R \wedge S) \to (P \vee T), (Q \to (U \wedge S), \neg T \Rightarrow Q \to P$.

15. Show that without using truth table
$((P \vee Q) \wedge \neg(\neg P \wedge (\neg Q \vee \neg R))) \vee (\neg P \vee \neg Q) \vee (\neg P \wedge \neg R)$ is a tautology

16. Establish the validity of the argument
$P \to Q, Q \to (R \wedge S), \neg R \vee (\neg T \vee U), P \wedge T \Rightarrow U$.

17. Establish the validity of the argument
$P, P \vee Q, Q \to (R \to S), T \to R \Rightarrow \neg S \to \neg T$.

18. Establish the validity of the argument

$(\neg P \vee Q) \rightarrow R, R \rightarrow (S \vee T), \neg S \wedge \neg U, \neg U \rightarrow \neg T \Rightarrow P$.

19.Establish the validity of the argument $\neg P \leftrightarrow Q, Q \rightarrow R, \neg R \Rightarrow P$.

20.Use Indirect method of proof show that $(x)(P(x) \vee Q(x)) \Rightarrow (x)P(x) \vee (\exists x)Q(x)$.

21.Prove that $(\exists x)P(x) \rightarrow (x)Q(x) \Rightarrow (x)(P(x) \rightarrow Q(x))$.

22.Use Conditional proof to prove that $(x)(P(x) \rightarrow Q(x)) \Rightarrow (x)P(x) \rightarrow (x)Q(x)$.

23.Prove that $(\exists x)(A(x) \vee B(x)) \Leftrightarrow (\exists x)A(x) \vee (\exists x)B(x)$.

24.Show that $(x)(P(x) \rightarrow Q(x)) \wedge (x)(Q(x) \rightarrow R(x)) \Rightarrow (x)(P(x) \rightarrow R(x))$.

25.Is the following conclusion validly derivable from the premises given?
If $(x)(P(x) \rightarrow Q(x)), (\exists y)P(y)$ then $(\exists z)Q(z)$.

26.Verify the validity of the inference: If one person is more successful than another, then he has worked harder to deserve success. John not worked harder than Peter. Therefore John is not successful than Peter.

27. Prove that $(\exists x)(P(x) \wedge Q(x)) \Rightarrow (\exists x)P(x) \wedge (\exists x)Q(x)$.Verify Whether the converse is true.

28. Show that $(\exists x)(F(x) \wedge S(x)) \rightarrow (y)(M(y) \rightarrow W(y)), (\exists y)(M(y) \wedge \neg W(y) \Rightarrow (x)(F(x) \rightarrow \neg S(x))$.

29. No junior (or) senior is enrolled in a physical education class.Mary is enrolled in a physical education class. Therefore Mary is

30. Show that $(x)(P(x) \vee Q(x)), (x)(\neg P(x) \wedge Q(x)) \rightarrow R(x)) \Rightarrow (x)(\neg R(x) \rightarrow P(x))$.

31. Express "$\sqrt{2}$ is an irrational number" using quantifiers.

32. Using CP or otherwise, show that the following implications
(a) $(\exists x)P(x) \rightarrow (x)Q(x) \Rightarrow (x)(P(x) \rightarrow Q(x))$ (b) $(x)(P(x) \rightarrow Q(x)) \Rightarrow (x)P(x) \rightarrow (x)Q(x)$.

UNIT-II
COMBINATORICS

1. (a) Prove, by mathematics induction, that for all n≥1, n^3+2n is a multiple of 3

(b) Use Mathematics induction to prove the inequality $n<2^n$ for all positive integer n

2. (a) Prove by the principle of mathematical induction, for 'n' a positive integer,

$$1^2 + 2^2 + 3^2 + \cdots + n^2 = \frac{n(n+1)(2n+1)}{6}$$

(b) Use Mathematical induction to show that $\frac{1}{\sqrt{1}} + \frac{1}{\sqrt{2}} + \cdots .. + \frac{1}{\sqrt{n}} > \sqrt{n}$, n≥2

3. (a) Using mathematical induction, prove that $1^2 + 2^2 + 3^2 + ... + (2n-1)^2 = \frac{n(2n-1)(2n+1)}{3}$

(b) Prove by mathematical induction that $6^{n+2}+7^{2n+1}$ is divisible by 43 for each positive integer n.

5. (a) Prove that in a group of six people, atleast three must be mutual friends or atleast three must be mutual strangers.

(b) From a club consisting of six men and seven women, in how many ways we select a committee Of (1) 3 men and four women? (2) 4 person which has at least one women? (3) 4 person that

has atmost one man? (4) 4 persons that has children of both sexes?

6. (a) How many bits of string of length 10 contain

(i)exactly four 1's
(ii)atmost four 1's
(iii)atleast four 1's
(iv)an equal number of 0's and 1's

(b) Find the number of distinct permutations that can be formed from all the letters of each word (1) RADAR (2) UNUSUAL.

7. (a) Suppose that there are 9 faculty members in the mathematics department and 11 in the computer science department. How many ways are there to select a committee to develop a discrete mathematics course at a school if the committee is to consist of three faculty members form the mathematics department and four from the computer science department?

(b) If n Pigeonholes are occupied by (kn+1) pigeons, where k is positive integer, prove that atleast one pigeonhole is occupied by k+1 or more pigeons. Hence, find the minimum number of m integers to be selected from S={1,2,…,9} so that the sum of the m integers are even.

8. (a) How many positive integers n can be formed using the digits 3,4,4,5,5,6,7 if n has to exceed 5000000?

(b) Find the number of integers between 1 and 250 both inclusive that are divisible by any of the integers 2,3,5,7.

9. (a) There are six men and five women in a room . Find the number of ways four person can be drawn from the room if (i) they can be male or female , (ii) two must be men and women , (iii) they must all are of the same sex.

(b) What is the maximum number of students required in a discrete mathematics class to be sure that at least six will receive the same grade if there are five possible grades A, B,C,D and E?

10. (a) Find the number of positive integers ≤1000 and not divisible by any of 3,5,7 and 22.

(b) A box contains six white balls and five red balls. Find the number of ways four balls can be drawn from the box if

(1) They can be any colour
(2) Two must be white and two red
(3)They must all be the same colour.

11. (a) Solve the recurrence relation $a_{n+1}-a_n=3n^2-n$, $n\geq 0$, $a_0=3$

(b) Solve the recurrence relation, $S(n)=S(n-1)+2(n-1)$, with $S(0)=3$, $S(1)=1$, by finding its generating function.

12. (a) Solve $G(k)-7G(k-1)+10G(k-2)=8k+6$, for $k\geq 2$.

(b) A factory makes custom sports cars at an increasing rate. In the first month only one car is made, in the second month two cars are made, and so on, with n cars made in the nth month.

(i) Set up recurrence relation for the number of cars produced in the first n months by this factory.
(ii) How many cars are produced in the first year?

13. (a) Solve the recurrence relation $a_n = -3a_{n-1} - 3a_{n-2} - a_{n-3}$ given that $a_0 = 5,\ a_1 = -9,\quad a2 = 15$

(b) Solve the recurrence relation $a_n = 3a_{n-1} + 2,\ \ n \geq 1$ with $a_0 = 1$ by method of generating Functions.

14. (a) Use generating functions to solve the recurrence relation $a_n+3a_{n-1}-4a_{n-2}=0$, $n\geq 2$ with the initial condition $a_0=3$, $a_1= -2$ (or) Solve $S_n+3S_{n-1}-4S_{n-2}=0$, $n\geq 2$ with the initial condition $S_0=3$, $S_1= -2$.

(b) Find the generating function of Fibonacci sequence.

15. (a) Use generating function to solve the recurrence relation $S(n+1)-2S(n)=4^n$ with $S(0)=1$, $n\geq 0$.
(b) Using method of generating function solve the recurrence relation

$a_n=4a_{n-1}-4a_{n-2}+4^n$; $n\geq 2$, given that $a_0=2$ and $a_1=8$.

16. (a) A total of 1232 students have taken a course in Spanish, 879 have taken a course in French, and 114 have taken a course in Russian. Further, 103 have taken courses in both Spanish and French, 23 have taken courses in both Spanish and Russian, and 14 have taken courses in both French and Russian. If 2092 students have taken atleast one of Spanish, French, and Russian, how many students have taken a course in all three languages?

(b) There are 2500 students in a college, of these 1700 have taken a course in C,1000 have taken a course Pascal and 550 have taken a course in Networking. Further 750 have taken courses in both C and Pascal. 400 have taken courses in both C and Networking, and 275 have taken courses in both Pascal and Networking. If 200 of these students have taken courses in C, Pascal and Networking.

(i) How many of these 2500 students have taken a course in any of these three courses C, Pascal and Networking? (ii) How many of these 2500 students have not taken a course in any of these three courses C, Pascal and Networking?

17. A valid code word is an n-digit decimal number containing even number of 0's. If a_n denotes the number of valid code words of length n then find an formula for a_n using generating functions.

UNIT-III

GRAPHS

1. (a) Prove that the number of vertices of odd degree in a graph is always even.

(b) Let G be a graph with exactly two vertices has odd degree. Then prove that there is a path between those two vertices.

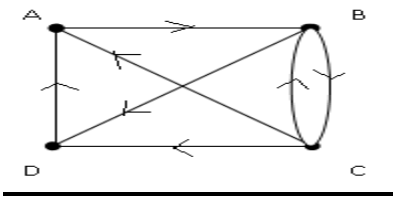
2. (a)Draw the graph with 5 vertices A,B,C,D and E such that deg(A)=3, B is an odd vertex,

deg(C)=2 and D and E are adjacent

(b)Definea complete graph K_nDrawacomplete graph K_6.Whatis thedegreeofeachvertexin K_n?Whatis thetotalnumberofedgesinK_n?

3. (a)State and prove hand shaking theorem. Also prove that maximum number of edges in a connected graph with n vertices is $\frac{n(n-1)}{2}$. (b) If G is self complementary graph, then prove that G has $n \equiv 0$ (or) 1(mod4) vertices.

3. (a) How many paths of length four are there from A to D in the simple graph G given below.

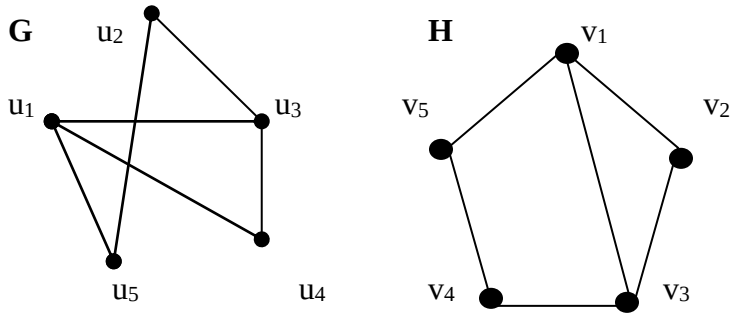


(b) Define (i) Adjacency matrix and (ii) Incidence matrix of a graph with example.

5. (a) Discuss the various graph invariants preserved by isomorphic graphs.

(b)Show that isomorphism of simple graphs is an equivalence relation.

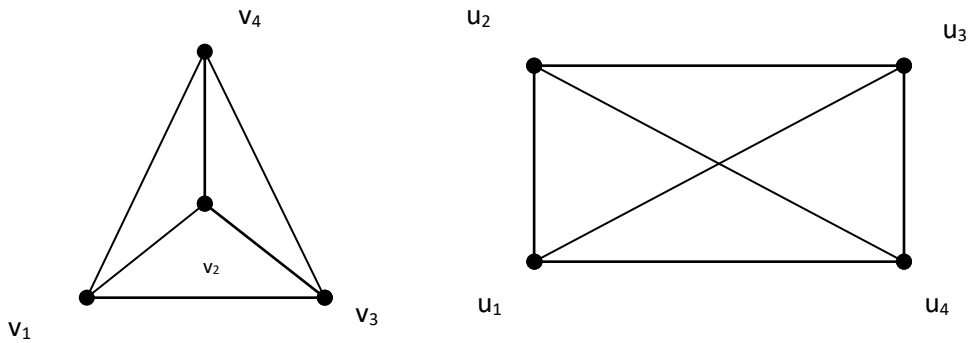
6. (a) Determine whether the following graphs G and H are isomorphic. Give reason



(b) Examine whether the following pairs of graphs G1 and G2 given in figures are isomorphic or not .

G1 **G2**

7. (a)Define Isomorphism. Establish an isomorphism for the following graphs.



(b)Define isomorphism between two graphs . Are the simple graphs with the following adjacency

matrices isomorphic?

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

8. (a) If Gisasimple graph withnverticeswithminimumdegree$\delta(G) \geq n/2$ showthat Gis connected.

(b) Show that a simple graph G with n vertices is connected if it has more than $\frac{(n-1)(n-2)}{2}$ Edges.

9. (a) Provethata graphGis connected ifandonlyif foranypartition ofVintosubsets V_1andV_2,thereexistsan edgejoiningavertexofV_1toavertexofV_2.

(b) Prove that the maximum number of edges in a simple disconnected graph G with n vertices and k components is $\frac{(n-k)(n-k+1)}{2}$.

10. (a)DefineEuleriangraphandHamiltoniangraph.Give anexampleof graphwhich is

(i) Eulerian but not Hamiltonian (ii) Hamiltonian and Eulerian

(iii) Hamiltonian but not Eulerian (iv) Neither Hamiltonian nor Eulerian

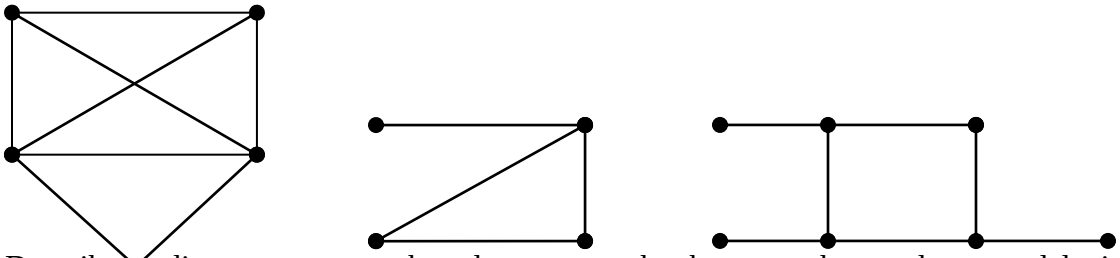
(b) Prove that a connected graph G is Euler graph if and only if every vertex of G is even degree.

11. (a) If G is a Connected simple graph with n vertices and the degree of vertex is atleast n/2,then show that G is Hamiltonian**.**

(b) Showthat$K_n$hasaHamiltoniancycle for$n \geq 3$.Whatisthemaximumnumberof edge–jointHamiltoncyclespossibleinK_n.Obtainall theedge–disjointHamilton cyclesinK_7.

12. (a) Let G be a simple indirected graph with n vertices. Let u and v be two non adjacent vertices in G such that $\deg(u)+\deg(v) \geq n$ in G. Show that G is Hamilltonian if and only if G+uv is Hamiltonian.

(b) Which of the following simple graphs have a Hamilton circuit or, if not, a Hamilton path?



13.(a) Describe a discrete structure based on a graph that can be used to model airline Routes and their flight times.(b) In a undirected graph, the number of odd degree vertices are even.

14.(a) If all the vertices of an undirected graph are each of degree K, show that the number of edges of the graph is a multiple of K.

(b) In a simple digraph G=(V,E), every node of the digraph lies in exactly one strong component.

15.(a)Show that a connected multi-graph has an Euler circuit if and only if each of its vertices has an even degree.

(b)Provethat thefollowingare equivalent:(i)Gis Eulerian(ii) EveryvertexofGhas evendegree(iii)ThesetofedgesofGcanbepartitionedintocycles.

UNIT-IV - ALGEBRIC STRUCTURES

1. Show that the mapping g from the algebraic system $(S,+)$ to the system $(T,\times)$ defined by $g(a)=s^a$,where S is the set of all rational numbers under $+$ and T is the set of non-zero real numbers under multiplication operation $\times$, is a homomorphism but not an isomorphism.

2. The intersection of any two subgroups of a group G is again a subgroup of G -Prove.

3. State & prove Lagrange's theorem for finite groups.

4. Find all the non-trivial subgroups of $(Z_6,+_6)$.

5. If every element of a group is its own inverse, prove that G is abelian. Is the converse true?

6. Prove that the direct product of two (or) more groups is again a group.

7. Show that monoid homomorphism preserves invertibility and monoid epimorphism preserves zero element (if it exist).

8. State and prove Fundamental theory on Homomorphism of groups

UNIT-V

LATTICES AND BOOLEAN ALGBRA

1. Let R denote a relation on the set of ordered pairs of positive integers such that $\langle x,y\rangle R\langle u,v\rangle$ iff $xv = yu$. Show that R is an equivalence relation.

2. Prove that the relation " Congruence modulo m" given by $\equiv = \{\langle x,y\rangle / x - y is divisible by m\}$ over the set of positive integers is an equivalence relation. Show also that if $x_1 = y_1$ & $x_2 = y_2$ then $(x_1 + x_2) = (y_1 + y_2)$.

3. Prove that distinct equivalence classes are disjoint.

4. In a lattice show that $a \le b$ & $c \le d$ implies $a * c \le b * d$.

5. In a distributive lattice prove that $a * b = a * c$ & $a \oplus b = a \oplus c$ implies $b = c$.

6. Let $P = \{\{1,2\},\{3,4\},\{5\}\}$ be a patition of the set $S = \{1,2,3,4,5\}$.Construct an equivalence R on S so that the equivalent classes with respect to R are precisely the members of

7. Show that a chain with two or more elements is not complemented.

8. Establish De Morgan's laws in a Boolean algebra.

9. In a distribute lattice, prove that the following are equivalent.

   (a) $a \wedge b \le x \le a \vee b$

   (b) $x = (a \wedge x) \vee (b \wedge x) \vee (a \wedge b)$

10. Prove that any chain 'a' is modular lattice.

11. In the Boolean algebra of all divisors of 70, find all sub algebras.

12. For any Boolean, prove

    1. $x \vee y = x \vee z, \bar{x} \vee y = \bar{x} \vee z \Rightarrow y = z.$ 2. $x \vee y = 0 \Leftrightarrow x = 0, y = 0.$

    3. $x \le \bar{y} \Leftrightarrow x \wedge y = 0.$ 4. $x \wedge y = 1 \Leftrightarrow x = 1, y = 1.$

13. Prove that in a distributive lattice every element has unique complement.

14. In any lattice prove that $a \wedge (b \vee c) \ge (a \wedge b) \vee (a \wedge c)$.

15. Let R be a relation on a set A. Then define $R^{-1} = \{\langle a,b\rangle \in A \times A / \langle b,a\rangle \in R\}$.Prove

that if $\langle A, R \rangle$ is a poset then $\langle \boldsymbol{A, R^{-1}} \rangle$ is also a poset.

16. Show that $\langle Z^{+}, / \rangle$ is distributive.

17. Show that every finite partial ordered set has a maximal and minimal element.

18. Show that if L is a distributive lattice then for all $\boldsymbol{a,b,c \in L}$

$\boldsymbol{(a*b)\oplus(b*c)\oplus(c*a)=(a\oplus b)*(b\oplus c)*(c\oplus a)}$.

19. In a Boolean algebra , Prove that $\boldsymbol{(a\wedge b)'=a'\vee b'}$ for all $\boldsymbol{a,b\in L}$.

DIGITAL PRINCIPLES AND SYSTEM DESIGN

UNIT-I / PART-B

1) Simplify the Boolean function using tabulation method.
F= (0, 1, 2, 8, 10, 11, 14, 15)

2) Determine the prime implicants of the function.

F= (1,4,6,7,8,9,10,11,15)

3) Simplify the Boolean function using K-map.

F(A,B,C,D,E) = (0,2,4,6,9,13,21,23,25,29,31)

4) Obtain the canonical sum of products of the function Y = AB + ACD Y = AB (C + C')(D + D') + ACD (B + B')

Y = ABCD + ABCD' + ABC'D + ABC'D' + AB'CD

5) Explain about TTL with neat diagrams.

6) Discuss all the characteristics of digital IC’s.

7) Explain with neat diagram how an open collector TTL operates.

8) Explain the different applications of open collector TTL.

9) Explain in detail about schottky TTL.

10) Explain in detail about three state gate.

11) Explain with necessary diagrams MOS & CMOS.

12) Design a 4-bit binary adder/subtractor circuit.

UNIT-II / PART-B

1) Explain the working of BCD Ripple Counter with the help of state diagram and logic diagram.

2) Design a logic circuit to convert the BCD code to Excess – 3 code.

3) Design and explain a comparator to compare two identical words. Two numbers represented by A = A3A2A1A0 & B = B3B2B1B0

4) Design a sequential detector which produces an output 1 every time the input sequence 1011 is detected.

5) Explain in detail about serial in serial out shift register.

6) Implement the switching function F= ∑ (0,1,3,4,7) using a 4 input MUX and explain

7) Explain how will build a 64 input MUX using nine 8 input MUXs

8) Implement the switching function F= ∑ (0,1,3,4,12,14,15) using an 8 input MUX

9) Explain how will build a 16 input MUX using only 4 input MUXs

10) Explain the operation of 4 to 10 line decoder with necessary logic diagram

11) Design full adder and full sub tractor.

12) Design a 4 bit magnitude comparator to compare two 4 bit number

13) Construct a combinational circuit to convert given binary coded decimal number into an Excess 3 code for example when the input to the gate is 0110 then the circuit should generate output as 1001

14) Using a single 7483, draw the logic diagram of a 4 bit adder/sub tractor

15) Realize a Binary to BCD conversion circuit starting from its truth table

16) Design a combinational circuit which accepts 3 bit binary number and converts its equivalent excess 3 codes

17) Explain carry look ahead adder.

18) Draw and explain BCD adder.

UNIT-III / PART-B

1) Explain the operation of JK and clocked JK flip-flops with suitable diagrams

2) Draw the state diagram of a JK flip- flop and D flip – flop

3) Design and explain the working of a synchronous mod – 3 counter

4) Design and explain the working of a synchronous mod – 7 counter

5) Design a synchronous counter with states 0,1, 2,3,0,1 ……. Using JK FF

6) Using SR flip flops, design a parallel counter which counts in the sequence 000,111,101,110,001,010,000

7) Using JK flip flops, design a parallel counter which counts in the sequence

000,111,101,110,001,010,000 …….

8) Draw and explain Master-Slave JK flip-flop.

9) Draw as asynchronous 4 bit up-down counter and explain its working

10) Using D flip –flop ,design a synchronous counter which counts in the sequence

000, 001, 010, 011, 100, 1001,110,111,000

11) Design a binary counter using T flip – flops to count in the following sequences:

000,001,010,011,100,101,110,111,000 - 000,100,111,010,011,000

12) Design a 3 bit binary Up-Down counter

13) Draw and explain the operation of four bit Johnson counter.

UNIT-IV / PART-B

1) Explain in detail about PLA with a specific example.

2) Implement the following using a mux. F(a,b,c,d) = (0,1,3,4,8,9,15) Obtain the truth table

3) Explain with neat diagrams a RAM architecture.

4) Explain in detail about PLA and PAL.

5) Explain with neat diagrams a ROM architecture.

6) Draw a RAM cell and explain its working.

7) Write short notes on (i) RAM (ii) Types of ROM's.

8) List the PLA program table for BCD to Excess -3-code convertor circuits and show its implementation for any two output functions.

9) Generate the following Boolean functions with PAL with 4inputs and 4outputs

10) Y3=A'BC'D+A'BCD'+A'BCD+ABC'D Y2=A'BCD'+A'BCD+ABCD
Y1=A'BC'+A'BC+AB'C+ABC' Y0=ABCD.

11) Implement the following functions using PLA.

12) F1=∑m(1,2,4,6); F2=∑m(0,1,6,7) F3=∑m(2,6)

13) Implement the given functions using PROM and PAL

14) F1=∑m(0,1,3,5,7,9); F2=∑m(1,2,4,7,8,10,11)

15) Implement the given functions using PAL, PLA

16) F1=∑m(0,1,2,4,6,7); F2=∑m(1,3,5,7); F3=∑m(0,2,3,6)

17) Draw the block diagram of a PLA device and briefly explain each block.

18) Design a 16 bit ROM array and explain the operation

19) Write short note on Field Programmable Gate Array (FPGA).

UNIT-V / PART-B

1) Explain with neat diagram the different hazards and the way to eliminate them.
2) State with a neat example the method for the minimization of primitive flow table.
3) Design a asynchronous sequential circuit with 2 inputs T and C. The output attains a value of 1 when T = 1 & c moves from 1 to 0. Otherwise the output is 0.
4) Explain in detail about Races.
5) Explain the different methods of state assignment
6) What is the objective of state assignment in asynchronous circuit? Give hazard – free realization for the following Boolean function f(A,B,C,D) = ∑m(0,2,6,7,8,10,12)
7) Summarize the design procedure for asynchronous sequential circuit
   Discuss on Hazards and races
8) Develop the state diagram and primitive flow table for a logic system that has 2 inputs, x and y and an output z. And reduce primitive flow table. The behavior of the circuit is stated as follows. Initially x=y=0. Whenever x=1 and y = 0 then z=1, whenever x = 0 and y = 1 then z = 0.When x=y=0 or x=y=1 no change in z ot remains in the previous state. The logic system has edge triggered inputs without having a clock .the logic system changes State on the rising edges of the 2 inputs. Static input values are not to have any effect in changing the Z output
9) Design an asynchronous sequential circuit with two inputs X and Y and with one output Z. Whenever Y is 1, input X is transferred to Z.When Y is 0, the output does not change for any change in X.
10) Obtain the primitive flow table for an asynchronous circuit that has two inputs x,y and one output Z. An output z =1 is to occur only during the input state xy = 01 and then if the only if the input state xy =01 is preceded by the input sequence.
11) A pulse mode asynchronous machine has two inputs. It produces an output whenever two consecutive pulses occur on one input line only .The output remains at '1' until a pulse has occurred on the other input line. Draw the state table for the machine.
12) Construct the state diagram and primitive flow table for an asynchronous network that has two inputs and one output. The input sequence X1X2 = 00,01,11 causes the output to become 1.The next input change then causes the output to return to 0.No other inputs will produce a 1 output.
13) Discuss on the different types of Hazards that occurs in asynchronous sequential circuits.
14) Write short note on races and cycles that occur in fundamental mode circuits.
15) Define the following terms: a. Critical race b. non-critical race. c. hazard d. flow table.

CS8391 - DATA STRUCTURES
UNIT I

LINEAR DATA STRUCTURES - LIST

1. Explain the various operations of the list ADT with examples
2. Write the program for array implementation of lists
3. Write a C program for linked list implementation of list.
4. Explain the operations of singly linked lists
5. Explain the operations of doubly linked lists
6. Explain the operations of circularly linked lists
7. How polynomial manipulations are performed with lists? Explain the operations
8. Explain the steps involved in insertion and deletion into an singly and doubly linked list.
9.Write an algorithm to perform insertion and deletion on a doubly linked list.
Nov / Dec 2015 & May / June 2014
10.Describe the creation of doubly linked list and appending the list. Give relevant coding in C. **Nov / Dec 2014**
11.Write algorithms for insertion and deletion of nodes in a linked list. **May / June 2006**
12. Explain the following: **Nov / Dec 2014**
(i) Applications of lists.

(ii) Polynomial Manipulations - Addition **Nov / Dec 2015**

13.Write a C program to perform addition, subtraction and multiplicationϖ operations on polynomial using linked list. **April / May 2015**

14. Write a C code for Circular linked list with create, insert, delete, display operations using structure pointer. **April / May 2015**

15. Discuss the implementation of list operations using array and write the C code for it. 16.Consider an Array [1:n] Given a position, write an algorithm to insert an elementϖ in the array. If the position is empty, the element is inserted easily. If the position is already occupied, the element should be inserted with the minimum number of shifts.

(Note: the elements can shift to the left or the right to make the minimum number of moves) **May / June 2014**

17.Write an algorithm to perform insertion and deletion on a doubly linked list.

18.Consider an array A[1..n]. Given a position, write an algorithm to insert an element in the array. If the position is empty, the element is inserted easily. If the position is already occupied the element should be inserted with the minimum number of shifts. (Note: the elements can shift to the left or right to make the minimum number of moves.)

19. Describe the creation of a doubly linked list and appending the list. give relevant coding in C. 20. Explain the following: (i) Application of Lists (ii) Polynomial manipulation

21.Write a C Program to perform addition, subtraction and multiplication operations on polynomial using linked list.

22. Write C code for circular linked list with create, insert, delete, display operations using structure pointer.

UNIT II
LINEAR DATA STRUCTURES – STACKS, QUEUES

1.Explain Stack ADT and its operations
2. Explain array based implementation of stacks
3. Explain linked list implementation of stacks
4. Explain the applications of Stacks
5. Explain how to evaluate arithmetic expressions using stacks
6. Explain queue ADT
7. Explain array based implementation of queues
8. Explain linked list implementation of queues
9. Explain the applications of queues
10. Explain circular queue and its implementation
11. Explain double ended queue and its operations
12.Explain the array and linked list implementation of stack.
13.Explain STACK ADT in detail. [**Nov/Dec 2014]**
14.Explain how stack is applied for evaluating an arithmetic expression. **[May2014]**
15.What are the applications of stack? Discuss in detail. **[Dec2014]**
16.Explain the array and linked list implementation of queue. **[May2015]**
17.Explain QUEUE ADT in detail. **[Dec2014]**
18.Explain circular queue and circular buffer in detail.
19.Write an algorithm to perform the four operations in a double ended queue that is implemented as an array. **[May/June 2014]**20.What is a circular queue and double ended queue? Give suitableϖ examples to differentiate them.
21.Write an algorithm to convert infix expression to a postfix expression. Trace the algorithm to convert the infix expression — (a+b)*c/d+e/f‖ to a postfix expression.
Explain the need for infix and postfix expression.
22. Write an algorithm to perform the four operations in a double ended queue that is implemented as an array.

23. Discuss about Stack ADT in detail. Explain any one application of Stack.
24. Explain about Queue ADT in detail. Explain any one application of Queue with suitable examples.
25.Write C program that checks if expression is correctly parenthesized using stack.
26.Write C program to implement Queue functions using arrays and Macros.
27. What is circular queue and double-ended queue? Give suitable examples to differentiate them. And Write a routine to implement the circular queue using array.
28. Discuss any two applications of stack with relevant examples.

UNIT III

NON LINEAR DATA STRUCTURES –TREES

1. Explain A VL Tree with Suitable example.
2. Explain B-Tree with Suitable example.
3. Explain Red-BlackTree with Suitable example.
4. Explain Splay Tree with Suitable Example.
5. Explain BinamialGHeap with Suitable example.
6. Explain fibonacciHeap with Suitable example
7. Explain briefly about disjoint set.
8. Build an AVL tree with the following values:
15, 20, 24, 10, 13, 7, 30, 36, 25 and Delete 13 and 25.
9.Build an Splay tree with the following values: 9 2 90 53 4 64 95 59
10. Buildan Red-Black tree with the following values: 15, 20, 24, 10, 13, 7, 30, 36, 25
11. Explain in detail the B-tree. What are its advantages? **(NOV/DEC 2012)**
12. Define AVL Trees. Explain its rotation operations with example**.(APRIL/MAY 2010)**
13.Explain heap structures. How are binary heaps implemented? Give its algorithm
With example. **(APRIL/MAY 2010,NOV/DEC 2007)**
14. Write a function to perform deletion of an element from a binary heap.**(NOV/DEC 2007)**
15. Show the result of inserting 2, l, 4, 5, 9, 3, 6, and 7 into an empty AVL tree. **(NOV/DEC 2007)**
16. Explain about rotations of AVL tree. **(NOV/DEC 2008)**
17. Write function to delete the minimum element from a binary heap. **(MAY/JUNE 2007)**
18. Write ADT operations for heap sort. Using the above algorithm, sort the following34,45,25,11,6,85,17,35.
19. Explain binary heaps in detail. Give its merits. **(NOV/DEC 2012)**
20. Explain about Kruskal algorithm with suitable example.
21. Explain about Prims with suitable example.

UNIT IV
NON LINEAR DATA STRUCTURES – GRAPHS

1.What is a strongly connected graph? Give an example.
2.Write the algorithm to compute lengths of shortest path.
3.Explain the depth first search algorithm. **(NOV/DEC 2009)**
4.. Explain in detail the Dijkstra's algorithm to solve the shortest path problem. **(NOV/DEC2010)**
5. Discuss in detail the applications of graphs. **(NOV/DEC2010)**
6.Explain Dijkstra's algorithm and solve the single source shortest path problem with an example.
7. Illustrate with an example, the linked list representation of graph.**(APRIL/MAY 2010)**
8. Write the procedures to perform the BFS and DFS search of a graph.
9. Explain Prim's algorithm to construct a minimum spanning tree from an undirected graph. **(APRIL/MAY 2010)**
10. Explain the Prim's algorithm to find minimum spanning tree for a graph. **(APRIL/MAY2004,NOV/DEC 2005,MAY/JUNE 2007,APRIL/MAY 2008)**
11. Write short notes on biconnectivity. **(MAY/JUNE 2007)**
12. Explain BFS and DFS in detail. Write the algorithm**.** **(NOV/DEC 2004)**

13. Explain topological sorting algorithm. **(NOV/Dec 2005,MAY/JUNE 2006)**
14. Write ADT routines for DFS algorithm. **(NOV/Dec 2006)**
15. Formulate an algorithm to find the shortest path using Dijkstra's algorithm.**(MAY/JUNE2007,APRIL/MAY 2008)**
16. Write an algorithm to find the minimum cost spanning tree of an weighted undirected graph. **(NOV/DEC 2007)**
17. What is single source shortest path problem? Discuss Dijikstra's single source shortest path algorithm with an example.
18. Explain Dijkstra's algorithm using the following graph' Find the shortest path between v1 to v2, v3, v4, v6, v7

UNIT V

SEARCHING, SORTING AND HASHING TECHNIQUES

1. Explain the sorting algorithms
2. Explain the searching algorithms
3. Explain hashing
4. Explain open addressing
5. Write a C program to sort the elements using bubble sort.
6. Write a C program to perform searching operations using linear and binary search.
7. Explain in detail about separate chaining.

8. Sort the given integers and show the intermediate results using shell sort 35,12,14,9,15,45,32,95,40,5

9.Write C code to sort an integer array using shell sort [**April/May 2015]**

10. Sort the given integers and show the intermediate results using selection sort 35,12,14,9,15,45,32,95,40,5

11. Write C code to sort an integer array using selection sort.

12. Sort the given integers and show the intermediate results using bubble sort 35,12,14,9,15,45,32,95,40,5

13.Write C code to sort an integer array using bubble sort

14. Write an algorithm to sort a set of 'N' numbers using quick sort. Trace the algorithm for the following set of numbers. 88,11,22,44,66,99,32,67,54,10 **[Nov/Dec 2014/Nov/Dec 2015/May/June 2014]**

15. Write an algorithm to sort a set of 'N' numbers using Merge sort. Trace the algorithm for the following set of numbers. 88,11,22,44,66,99,32,67,54,10 **[Nov/Dec 2015]**

16. Write an algorithm to sort a set of 'N' numbers using Radix sort. Trace the algorithm for the following set of numbers. 88,11,22,44,66,99,32,67,54,10

17. What are the different types of hashing techniques and collision resolution techniques? Explain them in detail with example. **[Nov/Dec 2014/Nov/Dec 2015/May/june 2014]**

18. Write C code to perform a. Linear Search, b. Binary search **[April/May 2015]**

19.Write notes on i. Rehashing ,ii. Extendible hashing **[April/May 2015]**

20. Given input {4371, 1323, 6173, 4199, 4344, 9679, 1989} and a hash function h(x)=x mod Show the result in:

i. Separate Chaining hash table:
ii. Open addressing hash table using linear probing
iii. Open addressing hash table using quadratic probing

iv. 4 Open addressing hash table with second hash function h2(x)=7-{x mod 7}
[May/June 2012]

21. Write short notes on hashing and the various collision resolution techniques.

22.Write an algorithm to sort n numbers using quick sort. Show how the following numbers are sorted using quick sort: 45, 28, 90, 1, 46, 39, 33, 87.

23. What are the different types of hashing techniques? Explain them in detail with example.

24. Write an algorithm to sort a set of numbers using quick sort. Trace the algorithm for the following set of numbers. 88, 11, 22, 44, 66, 99, 32, 67, 54, 10

25. Sort the given integers and show the intermediate results using shell sort.

26. Write C Code to sort an integer array using shell sort. (8) 35, 12, 14, 9, 15, 45, 32, 95, 40, 5 27. Write a C code to perform binary search.

28. Explain the rehashing techniques.

29.i) Sort the following sequence using Quick sort algorithm. Choose the pivot as median.

38, 81, 22, 48, 13 ,69, 93, 14 ,45, 58 ,79 ,72

(ii) Write a routine for Merge Sort.

30. Explain the following collision resolution strategies with example.

(i) Separate Chaining (5)

(ii) Linear Probing (5)

(iii) Quadratic Probing (6)

CS8392 OBJECT ORIENTED PROGRAMMING
UNIT I INTRODUCTION TO OOP AND JAVA FUNDAMENTALS
UNIT-I / PART-B

1 Explain the various features of the Object Oriented Programming Language
2 i) Describe the typical java program structure.
ii)Explain the general java program compilation and execution.
3 What are the different data types in JAVA? Explain each of them with example.
4 How to pass and return the objects to and from the method?
5 Discuss in detail the access specifiers available in Java.
6 Explain Packages in detail.
7 Explain Constructors with examples.
8 Explain in detail the various operators in Java.
9 Explain the concepts of arrays in Java and explain its types with examples?
10 Explain in detail about static variable and static method in Java with example?

UNIT II INHERITANCE AND INTERFACES
UNIT-II / PART-B

1 Explain the concept of inheritance with suitable examples.
2 State i) The properties of inheritance
ii) The design hints for inheritance

3 Explain interfaces with example.
4 Differentiate method overloading and method overriding. Explain both with an example program.
5 Differentiate method overloading and method overriding. Explain both with an example.
6 Explain about the object and abstract classes with the syntax.
7 Discuss in detail about inner class. With its advantages.
8 What is meant by object cloning? Explain it with an example.
9 Explain how inner classes and anonymous classes works in java program.
10 What is a Package? What are the benefits of using packages? Write down the steps in creating a package and using it in a java program with an example.
11 Explain arrays in java with suitable example.
12 How Strings are handled in java? Explain with code, the creation of Substring, Concatenation and testing for equality.

UNIT III EXCEPTION HANDLING AND I/O

UNIT-III / PART-B

1 Explain in detail the important methods of Java Exception Class?
2 Explain the different scenarios causing “Exception in thread main”?
3 How will you create your Own Exception Subclasses?
4 Explain in detail Chained exception with an example program.
5 Explain in detail the various exception types with its hierarchy.
6 Write programs to illustrate arithmetic exception, ArrayIndexOutOfBounds Exception and NumberFormat Exception.
7 Write a calculator program using exceptions and functions.
8 Create two exception classes that can be used by the stack classes developed by TRY
9 Write a program to receive the name of a file within a text field and then displays its contents within a text area.
10 Write a Java program that prints the maximum of the sequence of non-negative integer values that are stored on the file data.txt.
11 Write a program reads every single character from the file MyFile.txt and prints all the characters to the output console also write an example program which uses a BufferedReader that wraps a FileReader to append text to an existing file.

UNIT IV MULTITHREADING AND GENERIC PROGRAMMING

UNIT-IV / PART-B

1 What are the two ways of thread creation? Explain with suitable examples.
2 With illustrations explain multithreading, interrupting threads, thread states and thread properties.
3 Describe the life cycle of thread and various thread methods.
4 Explain the thread properties in detail.
5 Explain inter thread communication and suspending, resuming and stopping threads.
6 Write a java program that synchronizes three different threads of the same program and displays the contents of the text supplies through the threads.
7 Write a java program for inventory problem to illustrate the usage of thread synchronized keyword and inter thread communication process. They have three classes called consumer, producer and stock.
8 Explain in detail about generic classes and methods in java with suitable example.
9 Describe briefly about generics with wildcards.
10 What are the restrictions are considered to use java generics effectively? Explain in detail.

UNIT V EVENT DRIVEN PROGRAMMING
UNIT-V / PART-B

1 What is event delegation model and what are the event classes and event interfaces?
2 Explain various components in AWT?
3 What is event handling in java? List out the available event classes and listener interfaces with suitable example.
4 Explain the layout managers in Java also describe the concept of menu creation.
5 What is an adapter class? Describe about various adapter classes in detail?
6 Explain about JComboBoxclass, JCheckBoxclass
7 Develop a java program that have 11 text fields one submit button. When you press the button first 10 text field's average has to be displayed in the 11th text field.
8 Develop a java code that keeps the count of right clicks of mouse.
9 Explain about JButtonclass, JTextAreaclass, JFrameclass
10 Develop java program that changes the color of a filled circle when you make a right click.
11 An analysis of examination results at a school gave the following distribution of grades for all subjects taken in one year:

GRADES	PERCENTAGE
A	10
B	25
C	45
D	20

the distribution of each grade in a pie chart , where each Write a java program to represent sliceof pie is differently colored.
12 How will you display an image on the frame in a window using java.

COMMUNICATION ENGINEERING

UNIT I

1. Draw the block diagram for the generation and demodulation of a VSB signal and explain the principle of operation. (16)
2. Discuss the coherent detection of DSB-SC modulated wave with a block diagram of detector and Explain.
3. Explain the generation of AM signals using square law modulator (8)
4. Explain the super-heterodyne receiver (16)

5. With a neat block diagram explain super-heterodyne receivers. (16)
6. Explain in detail about the generation of SSB? (16)
7. a) Explain in detail about AM detector. (8)
   b) Write short notes on FDM (8)
8. Draw the circuit diagram of Foster –seeley discriminator and explain its working. (16)
9. Discuss the indirect method of generating the FM. (16)

UNIT II

1. Illustrate QPSK (16)
2. Write a note on Delta modulation (8)
3.Explain DPCM (16)
4. Write a detail note on PWM, PAM, and PPM (16)

5. With a suitable block diagram explain PCM transmitter and PCM receiver? (16)
6. For a PCM system with following parameters, determine (a) Minimum sample rate
(b) Minimum no of bits used in the PCM code. (iii) Quantization error.
Maximum analog input frequency = 4 kHZ
Maximum decoded voltage at receiver = ±2.55V
Minimum dynamic range = 46 dB (16)
7. a) With a suitable block diagram explain the operation of Delta modulation. (10)
b) Explain in detail about Adaptive Delta Modulation. (6)
8. Explain in detail about the Binary FSK and its bandwidth considerations. (16)
9. Derive the expression of propability of error on BPSK? (16)

UNIT III

1. Discuss Source coding theorem, give the advantage and disadvantage of channel coding in detail, and discuss the data compaction. (16)
2. Explain in detail Huffman coding algorithm and compare this with the other types of coding. (8)
3. Explain the properties of entropy and with suitable example, explain the entropy of binary memory less source. (8)
4. What is entropy? Explain the important properties of entropy. (8)
5. What do you mean by binary symmetric channel? Derive channel capacity formula for symmetric channel.

UNIT IV

1. Explain the source coding theorem.
2. Describe Shannon Fano coding.
3. Explain briefly the Huffman Coding algorithm.
4. Describe the Error control codes.
5. Explain the Viterbi algorithm.
6. Explain the sequential decoding techniques.

UNIT V

1. Explain TDMA in detail (10)
2. Write a note on cellular CDMA (16)
3. Compare TDMA, CDMA, SDMA
4. Explain in detail about advantages and drawbacks of TDMA, CDMA, SDMA (16)
5. Properties of PN sequences.
6. Explain in detail about DSSS and FHSS.