# UNIT-1 Questions

## Set Theory

1. Given $n(U) = 25, n(A) = 12, n(B) = 11, n(A \cap B')$=3, find $n(A \cup B')$.
2. Define power set and calculate Power set of a set $A = \{\phi, \{a, b\}\}$.
3. Prove for any two sets A and B that $(A \cup B)' = A' \cap B'$.
4. Given ϕ is an empty set, find $P(P(P(\phi)))$, where P is Power Set.
5. State and Prove both De-Morgan's laws using algebraic methods.
6. A total of 1232 student 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 at least one of Spanish, French, and Russian, how many students have taken a course in all three languages?

## Relation

7. Given the relation $R = \{(1,2), (2,1), (2,3), (3,4)\}$, on Set $A = \{1, 2, 3, 4\}$ find the transitive closure of $R$ using Warshall's algorithm.
8. How many reflexive relations are possible on a set of $n$ elements?
9. How many symmetric relations are possible on a set of $n$ elements?
10. How many Antisymmetric relations are possible on a set of $n$ elements?
11. Define equivalence class of an element 'a' w.r.t.an equivalence relation 'R'.
12. On the set of "web pages", define a relation R = {(a, b) | whosoever visits page 'a' also visits page 'b'}. What properties among reflexive, symmetric, transitive and antisymmetric are satisfied by R? Justify your answer.
13. Let R be binary relation on the set of all strings of 0's and 1's such that $\{(a, b) | a \text{ and } b \text{ are strings that have the same no of } 0's\}$. Is R being an equivalence relation? A Partial Ordering relation?
14. Let X= {1,2,3,4,5,6,7} and R={(x,y)| (x-y) is divisible by 3} Find R and check whether it is an equivalence relation or not. Draw the diagraph of R.
15. Show that a relation that is irreflexive and symmetric cannot be transitive.
16. Let R be a relation an set A={a,b,c,d} defined by R={(a , b),(b , c),(d , c ),(d , a),(a , d),(d ,d)} .Determine Reflexive closure of R, Symmetric Closure of R and Transitive Closure of R.

# Function

17. Let $f: R \to R$ be defined as: $f(x) = \sin(x) + \cos(x)$ & $f(x) = \frac{x^2+2x+3}{x+2}$ Find Range of $f$.
18. Define a bijective map from set A to set B.

19. Define Ackermann Function
20. Define primitive recursive function.
21. Let $f(x) = x + 2, g(x) = {}^{1}/_{x-2}, h(x) = 7x$ for $x \in R$ find the composition,

$i)\ fohog$ $ii)\ f^{-1}.g(x)$

22. 14. If $f: X \to Y$ & $g: Y \to Z$ be one-one and onto maps. Then Show that $(gof)^{-1} = f^{-1}og^{-1}$.
23. Using definition of order to show that $5x^2 - 3x + 4\ is\ O(x^3)$.
24. Differentiate function and relation with example.
25. Define Injective, surjective and bijective function.

# PMI

26. Prove that $\sqrt{3}$ is irrational number.
27. Prove that if n is a positive integer, then 133 divides $11^{n+1} + 122^{n-1.}$
28. Prove by mathematical induction 3+33+333+.............33..3 = (10n+1-9n-10)/27
29. Prove by induction: 1/1.2 +1/1.3+…….+1/n(n+1)= n/(n+1).

UNIT 2 Questions

30. Define order of an element in a group with suitable example.
31. Define Normal sub-group.
32. Prove that inverse of every element of a group in unique.
33. Define cyclic group.
34. Let $(\{a, b\},*)$ be a semi group where $a * a = b$ show that $a * b = b * a$
35. Define Sub-group. Show that if $H1$ & $H2$ are two sub-groups of groups $G$, then $H_1 \cap H_2$ is also a subgroup of G.
36. Define cyclic permutation? Show that $f = \begin{bmatrix} 1\,2\,3\,4\,5\,6\,7\,8\,9\,0 \\ 7\,3\,1\,8\,5\,6\,2\,4\,9\,0 \end{bmatrix}$ is even permutation?
37. Prove that intersection of two sub-groups of a group G can't be an empty set.
38. Define isomorphic group with an example.
39. Prove that every group of prime order is a cyclic.
40. State and prove Lagrange's theorem.
41. Prove that $(Z_6^+, \times_7)$ is a finite abelian group of order 6 under the modulo 7, as a composition in G.
42. Let Z be the set of integers, show that operation * on Z defined by $a * b = a + b + 1$ for all $a, b \in Z$ is a group?

43. Let G={a,b)| a,b ε R, a $\neq 0\}$. Define a binary operation * on G by (a,b)*(c,d)=(ac,bc+d) for all (a,b), (c,d) ε G. Show that (G,*) is not an abelian group.

44. The set $P(S)$ of all possible subset of a non-empty set $S$ under the composition $' *'$ defined by

$$(A * B) = A \cup B \text{ ¥ } A \dot{\subseteq} S, B \dot{\subseteq} S\ .$$

Show that $P(S)$ is not a group but it is a monoid.

45. Let <G, > be a group. Let H be a subset of G. Show that <H, *> is a subgroup of <G, *>

$$\text{iff } a, b \epsilon H \Longrightarrow ab^{-1} \epsilon H$$

46. Prove that cube root unity is a cyclic group under multiplication. Also identify all the generators.

47. Show that any group of elements less than or equal to four must be abelian.

48. Prove that $(Z_6, +_6)$ is an abelian group of order 6.

49. Prove that any group $G$ of order 3 is a cyclic.

50. Prove that the principle of mathematical induction, that the sum of finite number of terms of a geometric progression,

$$a + ar + ar^2 + \cdots + ar^{n-1} = {a(r^n - 1)}\Big/{(r-1)}\ if\ r \neq 1.$$

51. If $f: A \to B, g: B \to C$ are invertible functions, then show that $gof: A \to C$ is invertible and $(gof)^{-1} = f^{-1}og^{-1}$

52. Define Cosets. State and proof Lagrange's Theorem.

53. Let $(I, +)$ is a group of Integers and H is the subset of I is defined as $(\{\ldots \ldots. -6, -3,\ 0,\ 3, 6, 9 \ldots.\}, +)$

**54.** Let G be a group and let $a, b \in G$ be any element. Then

- $(a^{-1})^{-1} = a$
- $(a * b)^{-1} = b^{-1} *\ a^{-1}$
- The identity element in a group is unique

# UNIT 3 Question

55. Find the sum-of-products and Product of sum expansion of the Boolean function

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

F (x, y, z) = (x$y'$ + y) z'

F (x, y, z) = (xy + yz)

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

56. Solve Using K-Map $\mathrm{f(w,x,y,z)} = \Sigma(m_1, m_3, m_7, m_9, m_{11}, m_{14}, m_{15}) + \mathrm{d}(m_0, m_2, m_5\ )$. Also draw logical circuit.

57. Solve Using K-Map $\mathrm{f(a,b,c)} = \Sigma(1, 3, 5, 6, 7)$ Also draw logical circuit.

58. Solve Using K-Map $\mathrm{f(A,B,C,D)} = \Sigma(7,8,9,,10,11,12,13,14,15)$. expressed in sum of minterms and also draw logical circuit.

59. Solve Using K-Map $\mathrm{f(A,B,C,D)} = \Sigma(0, 1, 2, 8, 9, 12, 13) + \mathrm{d}(10, 11, 14, 15\ )$. d stand for don't care conditions, and also draw logical circuit.

60. Simplify the Boolean expression $A'B + BC' + BC + AB'C' = B + AC'$

## Unit-III -Lattice

1. For any positive integer $D_{36}$, then find whether ($D_{36}$,'|') is lattice or not?
2. Consider the divides relation on each of the following sets S. Draw the Hasse diagram for each relation. Find
   i. All minimal and maximal element.
   ii. Greatest and least element.
      a) S={2,3,5,30,60,120,180,360}
      b) S={1,2,3,4,6,9}
3. Explain Modular lattice, distribute lattice and bounded lattice with eg and diagram.
4. Draw the Hasse diagram of (A, ≤), where A= {3,4,12,24,48,72} and relation ≤ be such that a ≤ b if a divides b.
5. Draw the Hasse diagram for $D_{30}$.
6. Define a lattice. For a,b,c,d in a lattice (A,<=) if a<=b and c<=d then show that a˅c<=b˅ d and a^c<=b˅d
7. Show that the inclusion relation ⊆ is a partial ordering on the power set of a set S. Draw the Hasse diagram for inclusion on the set P(S), where S={a,b,c,d}. Also determine whether(P(S), ⊆)is a lattice.
8. Let (L,v,ʌ,≤) be a distributive lattice and a,bϵL. if aʌb=aʌc and avb=avc then show that b=c.
9. Prove that a lattice with 5 elements is not a Boolean algebra.
10. Let A = {1, 2, 3, 4, 6, 8, 9, 12, 18, 24} be ordered by the relation '**a** divides**b**'. Find the Hasse diagram.
11. If L be a lattice, then for every a and b in L prove that a ^ b = a if and only ifa ≤ b.
12. Prove that in any lattice the following distributive inequalities hold
    i. $a \wedge (b \vee c) \geq (a \wedge b) \vee (a \wedge c)$
    ii. $a \vee (b \wedge c) \leq (a \vee b) \wedge (a \vee c)$
13. Differentiate complemented lattice and distributed lattice.
14. Define Modular Lattice. Justify that if 'a' and 'b' are the elements in abounded distributive lattice and if 'a' has complement a'. then
    I) $a \vee (a' \wedge b) = a \vee b$ II ) $a \wedge (a' \vee b) = a \wedge b$
15. i) Justify that ($D_{36}$,\) is lattice.
    ii) Let $L_1$ be the lattice defined as $D_6$ and $L_2$ be the lattice (P(S), ≤), where P(S) be the power set defined on set S= {a, b}. Justify that the two lattices are isomorphic.
16. Find all sub lattices of $D_{24}$ that contain five or more elements.
17. Prove that if an element of a distributive lattice has a complement then that complement is unique.
18. Find the complement of each element of $D_{42}$.
19. Draw the Hasse diagram to illustrate the following partial ordering:
    i. The set of all subset of {1,2,3,4} having at least two numbers partially ordered by ⊆.
20. Prove that a non-empty finite partially ordered set has
    i. At most one greatest element
    ii. At most one least element.

## Unit -IV Important Questions

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| 1 | Translate the conditional statement “If it rains, then I will stay at home” into contrapositive, converse and inverse statement | |
| 2 | State Universal Modus Ponens and Universal Modus Tollens laws. | |
| 3 | Write the negation of the following statement: “If I wake up early in the morning, then I will be healthy.” | |
| 4 | Express the following statement in symbolic form: “All flowers are beautiful.” | |
| 5 | write the contra positive of the implication: "If it is Sunday then it is a holiday." | |
| 6 | Show that the prepositions $P \rightarrow Q$ and $\sim P \vee Q$ are logically equivalent. | |
| 7 | what are the contra positive, converse and inverse of the conditional statement "The home team wins whenver it is raining?" | |
| 8 | Find the contrapositive of –“If he has courage, then he will win” | |
| 9 | Construct the truth table for the following statements:<br>i) $(P \rightarrow Q') \rightarrow P'$ ii) $P \leftrightarrow (P' \vee Q')$. | |
| 10 | Use rules of inference to Justify that the three hypotheses<br>(i) “If it does not rain or if it is not foggy, then the sailing race will be held and the lifesaving demonstration will go on.”<br>(ii) “If the sailing race is held, then the trophy will be awarded.”<br>(iii) “The trophy was not awarded.” imply the conclusion<br>(iv) “It rained.” | |
| 11 | Justify that the following premises are inconsistent.<br>(i) If Nirmala misses many classes through illness then he fails high school.<br>(ii) If Nirmala fails high school, then he is uneducated.<br>(iii) If Nirmala reads a lot of books then he is not uneducated.<br>(iv) Nirmala misses many classes through illness and reads a lot of books | |
| 12 | Prove the validity of the following argument “If I get the job and work hard, then I will get promoted. If I get promoted, then I will be happy. I will not be happy. Therefore, either I will not get the job, or I will not work hard.” | |
| 13 | Define tautology, contradiction and contingency? Check whether $(p \vee q) \wedge (\sim p \vee r) \rightarrow (q \vee r)$ is a tautology, contradiction or contingency. | |
| 14 | Translate the following statements in symbolic form<br>i. The sum of two positive integers is always positive.<br>ii. Everyone is loved by someone.<br>iii. Some people are not admired by everyone.<br>iv. If a person is female and is a parent, then this person is someone’s mother. | |
| 15 | Explain various Rules of Inference for Propositional Logic. | |

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| 16 | Prove the validity of the following argument "If the races are fixed so the casinos are crooked, then the tourist trade will decline. if the tourist trade decreases, then the policewill be happy. The police force is never happy. Therefore, the races are not fixed." | |
| 17 | What is a tautology, contradiction and contingency? Show that (p v q) ∧ (~p v r) → (q v r) is a tautology, contradiction or contingency. | |
| 18 | Show that the premises "It is not sunny this afternoon and it is colder than yesterday," "We will go swimming only if it is sunny,""If we do not go swimming, then we will take acanoe trip," and "If we take a canoe trip, then we will be home by sunset"lead to the conclusion "We will be home by sunset." | |
| 19 | Translate the following sentences in quantified expressions of predicate logic. i) Allstudents need financial aid.<br>ii) Some cows are not white.<br>iii) Suresh will get if division if and only if he gets first div.<br>iv) if water is hot,then shyam will swim in pool.<br>v) All integer are either even or odd integer. | |
| 20 | Find whether the following argument is valid or not.<br>(1) No Engineering student is bad in studies. Abhishek is not bad in studies. Therefore Abhishek is an engineering student.<br>(2) All dogs are carnivorous. Some animals are dogs. Therefore some animals are carnivorous. | |

## Unit -V Important Questions

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| 1 | Explain Euler's formula. Determine number of regions if a planar graph has 30 vertices of degree 3 each. | |
| 2 | Explain pigeonhole principle with example. | |
| 3 | Define complete and regular graph | |
| 4 | Prove that the maximum number of vertices in a binary tree of height h is 2h+1, h ≥ 0. | |
| 5 | Obtain the generating function for the sequence 4, 4, 4,4 ,4 ,4, 4 | |
| 6 | Solve the recurrence relation using generating function. an+2- 5an+1 +6an =2, with a0=3 and a1=7 | |

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| 7 | Explain the following terms with example:<br>i. Graph coloring and chromatic number.<br>ii. How many edges in K7 and K3,3<br>iii. Isomorphic Graph and Hamiltonian graph.<br>iv. Bipartite graph.<br>v. Handshaking theorem | |
| 8 | i. Justify that "In a undirected graph the total number of odd degree vertices is even".<br>ii. Justify that "The maximum number of edges in a simple graph is n(n-1)/2" | |
| 9 | If a connected planar graph G has n vertices, e edges and r region, then $n – e + r = 2$. | |
| 10 | Construct the binary tree whose inorder and preorder traversal is given below. Also, find the postorder traversal of the tree. Inorder: d,g, b, e, i, h, j, a, c, f<br>Preorder: a, b, d, g, e, h, i, j, c, f | |
| 11 | Solve the following recurrence relation an – an – 1 + 20an – 2 = 0 where a0 = – 3 , a1 = – 10 | |
| 12 | Solve the following recurrence relation using generating function<br>G(K) - 7 G(K-1) +10 G(K-2) = 8K+6 | |

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| 13 | A collection of 10 electric bulbs contain 3 defective ones<br>(i) In how many ways can a sample of four bulbs be selected?<br>(ii) In how many ways can a sample of 4 bulbs be selected which contain 2 good bulbs and 2 defective ones?<br>(iii) In how many ways can a sample of 4 bulbs be selected so that either the samle contains 3 good ones and 1 defectives onces or 1good and 3 defectives ones? | |
| 14 | Define a Binary Tree. A binary tree has 11 nodes. It's inorder and preorder traversal node sequences are:Preorder: ABDHIEJKCFG<br>In-order: HDIBJEKAFCG.<br>Draw the tree. | |
| 15 | What are different ways to represent a graph. Define Euler Circuit and Euler graph. Give necessary and sufficient conditions for Euler circuits and paths. | |
| 16 | Suppose that a valid codeword is an n-digit number in decimal notation containing an even number number of 0's. Let an denote the number of valid codewords of length n satisying the recurrence relation an = 8an-1 + 10n-1 and the initial condition a1 = 9. Use generating functions to find an explicit formula for an. | |