

Discrete Mathematics

12th Standard

Maths

Exam Time : 00:40:00 Hrs

Total Marks : 40

40 x 1 = 40

- 1) A binary operation on a set S is a function from
 (a) $S \rightarrow S$ (b) $(S \times S) \rightarrow S$ (c) $S \rightarrow (S \times S)$ (d) $(S \times S) \rightarrow (S \times S)$
- 2) Subtraction is not a binary operation in
 (a) R (b) Z (c) N (d) Q
- 3) Which one of the following is a binary operation on N?
 (a) Subtraction (b) Multiplication (c) Division (d) All the above
- 4) In the set R of real numbers '*' is defined as follows. Which one of the following is not a binary operation on R?
 (a) $a*b = \min(a, b)$ (b) $a*b = \max(a, b)$ (c) $a*b = a$ (d) $a*b = a^b$
- 5) The operation * defined by $a*b = \frac{ab}{7}$ is not a binary operation on
 (a) Q^+ (b) Z (c) R (d) C
- 6) In the set Q define $a \odot b = a + b + ab$. For what value of y, $3 \odot (y \odot 5) = 7$?
 (a) $y = \frac{2}{3}$ (b) $y = \frac{-2}{3}$ (c) $y = \frac{-3}{2}$ (d) $y = 4$
- 7) If $a*b = \sqrt{a^2 + b^2}$ on the real numbers then * is
 (a) commutative but not associative (b) associative but not commutative (c) both commutative and associative (d) neither commutative nor associative
- 8) Which one of the following statements has the truth value T?
 (a) $\sin x$ is an even function (b) Every square matrix is non-singular (c) The product of complex number and its conjugate is purely imaginary (d) $\sqrt{5}$ is an irrational number
- 9) Which one of the following statements has truth value F?
 (a) Chennai is in India or $\sqrt{2}$ is an integer (b) Chennai is in India or $\sqrt{2}$ is an irrational number (c) Chennai is in China or $\sqrt{2}$ is an integer (d) Chennai is in China or $\sqrt{2}$ is an irrational number
- 10) If a compound statement involves 3 simple statements, then the number of rows in the truth table is
 (a) 9 (b) 8 (c) 6 (d) 3
- 11) Which one is the inverse of the statement $(P \vee Q) \rightarrow (P \wedge Q)$?
 (a) $(P \wedge Q) \rightarrow (P \vee Q)$ (b) $(P \vee Q) \rightarrow (P \wedge Q)$ (c) $(\neg P \vee \neg Q) \rightarrow (\neg P \wedge \neg Q)$ (d) $(\neg P \wedge \neg Q) \rightarrow (\neg P \vee \neg Q)$
- 12) Which one is the contrapositive of the statement $(p \vee q) \rightarrow r$?
 (a) $\neg r \rightarrow (\neg p \wedge \neg q)$ (b) $\neg r \rightarrow (p \vee q)$ (c) $r \rightarrow (p \wedge q)$ (d) $p \rightarrow (q \vee r)$
- 13) The truth table for $(p \wedge q) \vee \neg q$ is given below

p	q	$(p \wedge q) \vee (\neg q)$
T	T	(a)
T	F	(b)
F	T	(c)
F	F	(d)

Which one of the following is true?

(a)

(a)	(b)	(c)	(d)
T	T	T	T

(b)

(a)	(b)	(c)	(d)
T	F	T	T

(c)

(a)	(b)	(c)	(d)
T	T	F	F

(d)

(a)	(b)	(c)	(d)
T	F	F	F

14) In the last column of the truth table for $\neg(p \vee \neg q)$ the number of final outcomes of the truth value 'F' are

(a) 1

(b) 2

(c) 3

(d) 4

15) Which one of the following is incorrect? For any two propositions p and q, we have

(a) $\neg(p \vee q) \equiv \neg p \wedge \neg q$ (b) $\neg(p \wedge q) \equiv \neg p \vee \neg q$ (c) $\neg(p \vee q) \equiv \neg p \vee \neg q$ (d) $\neg(\neg p) \equiv p$

16)

p	q	$(p \wedge q) \rightarrow \neg q$
T	T	(a)
T	F	(b)
F	T	(c)
F	F	(d)

T T (a)

T F (b)

F T (c)

F F (d)

Which one of the following is correct for the truth value of $(p \wedge q) \rightarrow \neg p$?

(a)

(a)	(b)	(c)	(d)
T	T	T	T

(b)

(a)	(b)	(c)	(d)
F	T	T	T

(c)

(a)	(b)	(c)	(d)
F	F	T	T

(d)

(a)	(b)	(c)	(d)
T	T	T	F

17) The dual of $\neg(p \vee q) \vee [p \vee (p \wedge \neg r)]$ is

(a) $\neg(p \wedge q) \wedge [p \vee (p \wedge \neg r)]$ (b) $(p \wedge q) \wedge [p \wedge (p \wedge \neg r)]$ (c) $\neg(p \wedge q) \wedge [p \wedge (p \wedge r)]$ (d) $\neg(p \wedge q) \wedge [p \wedge (p \vee \neg r)]$

18) The proposition $p \wedge (\neg p \vee q)$ is

(a) a tautology (b) a contradiction (c) logically equivalent to $p \wedge q$ (d) logically equivalent to $p \vee q$

19) Determine the truth value of each of the following statements:

(a) $4+2=5$ and $6+3=9$

(b) $3+2=5$ and $6+1=7$

(c) $4+5=9$ and $1+2=4$

(d) $3+2=5$ and $4+7=11$

(a)

(a)	(b)	(c)	(d)
F	T	T	T

(b)

(a)	(b)	(c)	(d)
T	F	T	F

(c)

(a)	(b)	(c)	(d)
T	T	F	F

(d)

(a)	(b)	(c)	(d)
F	F	T	T

20) Which one of the following is not true?

(a) Negation of a statement is the statement itself (b) If the last column of the truth table contains only T then it is a tautology. (c) If the last column of its truth table contains only F then it is a contradiction (d) If p and q are any two statements then $p \leftrightarrow q$ is a tautology.

21) The binary operation * defined on a set S is said to be commutative if

(a) $a*b \in S \forall a, b \in S$ (b) $a*b = b*a \forall a, b \in S$ (c) $(a*b)*c = a*(b*c) \forall a, b \in S$ (d) $a*b = e \forall a, b \in S$

22) If * is defined by $a*b = a^2 + b^2 + ab + 1$, then $(2*3)*2$ is

(a) 20

(b) 40

(c) 400

(d) 445

23) The number of binary operations that can be defined on a set of 3 elements is

(a) 3^2

(b) 3^3

(c) 3^9

(d) 3^1

24) The Identity element of $\left\{ \begin{pmatrix} x & x \\ x & x \end{pmatrix} \mid x \in \mathbb{R}, x \neq 0 \right\}$ under matrix multiplication is

(a) $\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$ (b) $\begin{pmatrix} \frac{1}{4x} & \frac{1}{4x} \\ \frac{1}{4x} & \frac{1}{4x} \end{pmatrix}$ (c) $\begin{pmatrix} \frac{1}{2} & \frac{1}{2} \\ \frac{1}{2} & \frac{1}{2} \end{pmatrix}$ (d) $\begin{pmatrix} \frac{1}{2x} & \frac{1}{2x} \\ \frac{1}{2x} & \frac{1}{2x} \end{pmatrix}$

25) Which one of the following is not a statement?

- (a) $2 + 3 = 5$ (b) How beautiful is this flower? (c) Delhi is the capital of Tamil Nadu (d) A triangle has found angles.

26) Which of the following is a tautology?

- (a) $p \vee q$ (b) $p \wedge q$ (c) $q \vee \sim q$ (d) $q \wedge \sim q$

27) Which of the following is a contradiction?

- (a) $p \vee q$ (b) $p \wedge q$ (c) $q \vee \sim q$ (d) $q \wedge \sim q$

28) The identity element in the group $\{R - \{1\}, x\}$ where $a * b = a + b - ab$ is

- (a) 0 (b) 1 (c) $\frac{1}{a-1}$ (d) $\frac{a}{a-1}$

29) Define $*$ on Z by $a * b = a + b + 1 \forall a, b \in Z$. Then the identity element of z is

- (a) 1 (b) 0 (c) 1 (d) -1

30) A binary operation $*$ is defined on the set of positive rational numbers Q^+ by $a * b = \frac{ab}{4}$.

Then $3 * \left(\frac{1}{5} * \frac{1}{2}\right)$ is

- (a) $\frac{3}{160}$ (b) $\frac{5}{160}$ (c) $\frac{3}{10}$ (d) $\frac{3}{40}$

31) If $a * b = a^2b^2 - ab$ then $3 * (1 * 1)$

- (a) 0 (b) 1 (c) 2 (d) 4

32) The number whose multiplication universe does not exist in C .

- (a) 0 (b) 1 (c) 0 (d) 1

33) Let p : Kamala is going to school

q : There are 20 students in the class. Then Kamala is not going to school or there are 20 students in the class is represented by

- (a) $p \vee q$ (b) $p \wedge q$ (c) $\sim p$ (d) $\sim p \vee q$

34) If p is true and q is unknown, then _____

- (a) $\sim p$ is true (b) $p \vee (\sim p)$ is false (c) $p \wedge (\sim p)$ is true (d) $p \vee q$ is true

35) '+' is not a binary operation on

- (a) $\sim$ (b) z (c) c (d) $Q - \{0\}$

36) '-' is a binary operation on

- (a) $\sim$ (b) $Q - \{0\}$ (c) $R - \{0\}$ (d) Z

37) Which of the following is a statement?

- (a) $7 + 2 < 10$ (b) Wish you all success (c) All the best (d) How old are you?

38) In $(N, *)$, $x * y = \max(x, y)$, $x, y \in N$ then $7 * (-7)$

- (a) 7 (b) -7 (c) 0 (d) -49

39) In $(S, *)$, is defined by $x * y = x$ where $x, y \in S$, then

- (a) associative (b) commutative (c) associative and commutative (d) neither associative nor commutative

40) The number of commutative binary operations which can be defined on a set containing n elements is

- (a) $\frac{n(n+1)}{2}$ (b) n^{n^2} (c) $n^{\frac{n}{2}}$ (d) n^2

Discrete Mathematics

12th Standard

Maths

Exam Time : 01:15:00 Hrs

Total Marks : 50

25 x 2 = 50

- 1) Examine the binary operation (closure property) of the following operations on the respective sets (if it is not, make it binary)
 $a*b = a + 3ab - 5b^2; \forall a, b \in \mathbb{Z}$
- 2) Verify the
 - (i) closure property,
 - (ii) commutative property,
 - (iii) associative property
 - (iv) existence of identity and
 - (v) existence of inverse for the arithmetic operation $+$ on $\mathbb{Z}_0$ = the set of all even integers
- 3) Let $A = \begin{bmatrix} 0 & 1 \\ 1 & 1 \end{bmatrix}$, $B = \begin{bmatrix} 1 & 1 \\ 0 & 1 \end{bmatrix}$ be any two boolean matrices of the same type. Find $A \vee B$ and $A \wedge B$.
- 4) Determine whether $*$ is a binary operation on the sets given below.
 $a*b = \min(a, b)$ on $A = \{1, 2, 3, 4, 5\}$
- 5) On $\mathbb{Z}$, define $\otimes$ by $(m \otimes n) = mn + nm; \forall m, n \in \mathbb{Z}$. Is $\otimes$ binary on $\mathbb{Z}$?
- 6) Let $A = \{a + \sqrt{5}b : a, b \in \mathbb{Z}\}$. Check whether the usual multiplication is a binary operation on A .
- 7) Write each of the following sentences in symbolic form using statement variables p and q .
 - (i) 19 is not a prime number and all the angles of a triangle are equal.
 - (ii) 19 is a prime number or all the angles of a triangle are not equal
 - (iii) 19 is a prime number and all the angles of a triangle are equal
 - (iv) 19 is not a prime number
- 8) Which one of the following sentences is a proposition?
 - (i) $4 + 7 = 12$
 - (ii) What are you doing?
 - (iii) $3n \leq 8, 1 \leq n \in \mathbb{N}$
 - (iv) Peacock is our national bird
 - (v) How tall this mountain is!
- 9) Consider the binary operation $*$ defined on the set $A = \{a, b, c, d\}$ by the following table:

*	a	b	c	d
a	a	a	b	d
b	c	d	a	a
d	d	b	a	c

Is it commutative and associative?
- 10) Construct the truth table for the following statements.
 $\neg p \wedge \neg q$

- 11) Construct the truth table for the following statements.
 $(p \vee q) \wedge \neg q$
- 12) Show that $p \vee (\neg p)$ is a tautology.
- 13) In the set of integers under the operation $*$ defined by $a * b = a + b - 1$. Find the identity element.
- 14) Let $G = \{1, w, w^2\}$ where w is a complex cube root of unity. Then find the universe of w^2 . Under usual multiplication.
- 15) Check whether dot product is defined on the set of vectors. Explain?
- 16) In $\mathbb{Z}$, the set of integers, an operation $*$ is defined as $a \boxtimes b = 2(a+b)$. Check whether $*$ is associative.
- 17) If $a \equiv b \pmod{n}$ and $b \equiv c \pmod{n}$, check whether $a \equiv c \pmod{n}$.
- 18) Give any four Boolean Matrices of order 2×2
- 19) A and B are Boolean matrices of order 2×2 . If $AVB = A$, is it necessary that

$$B = \begin{pmatrix} 0 & 0 \\ 0 & 0 \end{pmatrix}$$
- 20) An operation $*$ is defined as $m \times n = m^n - n^m$. Is it binary on $\mathbb{N}$?
- 21) Form the truth table of $(\neg P) \rightarrow (\neg q)$.
- 22) Are $\neg p \vee (p \vee q)$ and $p \vee (\neg p \vee q)$ tautology statements. Justify your answer.
- 23) $p: \mathbb{N}$ is divisible by 4 and $q: \mathbb{N}$ is an even number. Whether $p \rightarrow q$ is true.
- 24) Give the truth table of $\neg p \rightarrow \neg q$
- 25) Give the truth value of $(\neg p \vee q) \vee (\neg q)$

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Discrete Mathematics 2M

Date : 08-Nov-19

12th Standard

Maths

Reg.No. :

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Exam Time : 00:50:00 Hrs

Total Marks : 50

25 x 2 = 50

- 1) Examine the binary operation (closure property) of the following operations on the respective sets (if it is not, make it binary)

$$a * b = a + 3ab - 5b^2; \forall a, b \in \mathbb{Z}$$

- 2) Examine the binary operation (closure property) of the following operations on the respective sets (if it is not, make it binary)

$$a * b = \left(\frac{a-1}{b-1} \right), \forall a, b \in \mathbb{Q}$$

- 3) Verify the

(i) closure property,

(ii) commutative property,

(iii) associative property

(iv) existence of identity and

(v) existence of inverse for the arithmetic operation + on $\mathbb{Z}$.

- 4) Let $A = \begin{bmatrix} 0 & 1 \\ 1 & 1 \end{bmatrix}, B = \begin{bmatrix} 1 & 1 \\ 0 & 1 \end{bmatrix}$ be any two boolean matrices of the same type. Find $A \vee B$ and $A \wedge B$.

- 5) Let p: Jupiter is a planet and q: India is an island be any two simple statements. Give verbal sentence describing each of the following statements.

(i) $\neg p$

(ii) $p \wedge \neg q$

(iii) $\neg p \vee q$

(iv) $p \rightarrow \neg q$

(v) $p \leftrightarrow q$

- 6) Write each of the following sentences in symbolic form using statement variables p and q.

(i) 19 is not a prime number and all the angles of a triangle are equal.

(ii) 19 is a prime number or all the angles of a triangle are not equal

(iii) 19 is a prime number and all the angles of a triangle are equal

(iv) 19 is not a prime number

- 7) Determine the truth value of each of the following statements

(i) If $6 + 2 = 5$, then the milk is white.

(ii) China is in Europe or $\sqrt{3}$ is an integer

(iii) It is not true that $5 + 5 = 9$ or Earth is a planet

(iv) 11 is a prime number and all the sides of a rectangle are equal

- 8) Which one of the following sentences is a proposition?

(i) $4 + 7 = 12$

(ii) What are you doing?

(iii) $3n \leq 8, 1 \leq n \in \mathbb{N}$

(iv) Peacock is our national bird

(v) How tall this mountain is!

- 9) Fill in the following table so that the binary operation * on $A = \{a, b, c\}$ is commutative.

*	a	b	c
a			
b			
c			

b	c	b	a
c	a		c

- 10) Write the converse, inverse, and contrapositive of each of the following implication.
 - (i) If x and y are numbers such that $x = y$, then $x^2 = y^2$
 - (ii) If a quadrilateral is a square then it is a rectangle.
- 11) Construct the truth table for the following statements.

$$\neg p \wedge \neg q$$
- 12) Construct the truth table for the following statements.

$$\neg(p \wedge \neg q)$$
- 13) Construct the truth table for the following statements.

$$(p \vee q) \wedge \neg q$$
- 14) Construct the truth table for the following statements.

$$(\neg p \rightarrow r) \wedge (p \leftrightarrow q)$$
- 15) Verify whether the following compound propositions are tautologies or contradictions or contingency

$$(p \wedge q) \neg (p \vee q)$$
- 16) Verify whether the following compound propositions are tautologies or contradictions or contingency

$$((p \vee q) \wedge \neg p) \rightarrow q$$
- 17) Verify whether the following compound propositions are tautologies or contradictions or contingency

$$(p \rightarrow q) \leftrightarrow (\neg p \rightarrow q)$$
- 18) Show that

$$\neg(p \wedge q) \equiv \neg p \vee \neg q$$
- 19) Show that $q \rightarrow p \equiv \neg p \rightarrow \neg q$
- 20) Show that $p \rightarrow q$ and $q \rightarrow p$ are not equivalent
- 21) Show that $\neg(p \leftrightarrow q) \equiv p \leftrightarrow \neg q$
- 22) Check whether the statement $p \rightarrow (q \rightarrow p)$ is a tautology or a contradiction without using the truth table.
- 23) Using truth table check whether the statements $\neg(p \vee q) \vee (\neg p \wedge q)$ and $\neg p$ are logically equivalent.
- 24) Prove $p \rightarrow (q \rightarrow r) \equiv (p \wedge q) \rightarrow r$ without using truth table.
- 25) Prove that $p \rightarrow (\neg q \vee r) \equiv \neg p \vee (\neg q \vee r)$ using truth table.

- 1) Verify the
 - (i) closure property,
 - (ii) commutative property,
 - (iii) associative property
 - (iv) existence of identity and
 - (v) existence of inverse for the arithmetic operation - on $\mathbb{Z}$.
- 2) Verify the
 - (i) closure property,
 - (ii) commutative property,
 - (iii) associative property
 - (iv) existence of identity and
 - (v) existence of inverse for the arithmetic operation + on $\mathbb{Z}_e$ = the set of all even integers
- 3) Verify the
 - (i) closure property,
 - (ii) commutative property,
 - (iii) associative property
 - (iv) existence of identity and
 - (v) existence of inverse for the arithmetic operation + on $\mathbb{Z}_o$ = the set of all even integers
- 4) Verify
 - (i) closure property
 - (ii) commutative property, and
 - (iii) associative property of the following operation on the given set.
 $(a*b) = a^b; \forall a, b \in \mathbb{N}$ (exponentiation property)
- 5) Determine whether * is a binary operation on the sets given below.
 $a*b = b = a \cdot |b|$ on $\mathbb{R}$
- 6) Determine whether * is a binary operation on the sets given below.
 $a*b = \min(a, b)$ on $A = \{1, 2, 3, 4, 5\}$
- 7) Determine whether * is a binary operation on the sets given below.
 $(A*v) = a\sqrt{b}$ is binary on $\mathbb{R}$
- 8) On $\mathbb{Z}$, define $\otimes$ by $(m \otimes n) = mn + nm: \forall m, n \in \mathbb{Z}$. Is $\otimes$ binary on $\mathbb{Z}$?
- 9) Let * be defined on $\mathbb{R}$ by $(a*b) = a + b + ab - 7$. is * binary on $\mathbb{R}$? If so, find $3\left(\frac{-7}{15}\right)$.
- 10) Let $A = \{a + \sqrt{5}b : a, b \in \mathbb{Z}\}$. Check whether the usual multiplication is a binary operation on A.
- 11) Consider the binary operation * defined on the set $A = \{a, b, c, d\}$ by the following table:

*	a	b	c	d
a	a	a	c	b
b	a	a	c	b
c	a	a	c	b
d	a	a	c	b

b	c	d	a	a
d	d	b	a	c

Is it commutative and associative?

- 12) Let $A = \begin{pmatrix} 1 & 0 & 1 & 0 \\ 0 & 1 & 0 & 1 \\ 1 & 0 & 0 & 1 \end{pmatrix}$, $B = \begin{pmatrix} 0 & 1 & 0 & 1 \\ 1 & 0 & 1 & 0 \\ 1 & 0 & 0 & 1 \end{pmatrix}$, $C = \begin{pmatrix} 1 & 1 & 0 & 1 \\ 0 & 1 & 1 & 0 \\ 1 & 1 & 1 & 1 \end{pmatrix}$ be any three boolean matrices of the same type.

Find AVB

- 13) Let $A = \begin{pmatrix} 1 & 0 & 1 & 0 \\ 0 & 1 & 0 & 1 \\ 1 & 0 & 0 & 1 \end{pmatrix}$, $B = \begin{pmatrix} 0 & 1 & 0 & 1 \\ 1 & 0 & 1 & 0 \\ 1 & 0 & 0 & 1 \end{pmatrix}$, $C = \begin{pmatrix} 1 & 1 & 0 & 1 \\ 0 & 1 & 1 & 0 \\ 1 & 1 & 1 & 1 \end{pmatrix}$ be any three boolean matrices of the same type.

Find $A \wedge B$

- 14) Let $A = \begin{pmatrix} 1 & 0 & 1 & 0 \\ 0 & 1 & 0 & 1 \\ 1 & 0 & 0 & 1 \end{pmatrix}$, $B = \begin{pmatrix} 0 & 1 & 0 & 1 \\ 1 & 0 & 1 & 0 \\ 1 & 0 & 0 & 1 \end{pmatrix}$, $C = \begin{pmatrix} 1 & 1 & 0 & 1 \\ 0 & 1 & 1 & 0 \\ 1 & 1 & 1 & 1 \end{pmatrix}$ be any three boolean matrices of the same type.

Find $(A \vee B) \wedge C$

- 15) Let $A = \begin{pmatrix} 1 & 0 & 1 & 0 \\ 0 & 1 & 0 & 1 \\ 1 & 0 & 0 & 1 \end{pmatrix}$, $B = \begin{pmatrix} 0 & 1 & 0 & 1 \\ 1 & 0 & 1 & 0 \\ 1 & 0 & 0 & 1 \end{pmatrix}$, $C = \begin{pmatrix} 1 & 1 & 0 & 1 \\ 0 & 1 & 1 & 0 \\ 1 & 1 & 1 & 1 \end{pmatrix}$ be any three boolean matrices of the same type.

Find $(A \wedge B) \vee C$

Discrete Mathematics

12th Standard

Maths

Exam Time : 01:30:00 Hrs

Total Marks : 60

20 x 3 = 60

- 1) Verify the
 - (i) closure property,
 - (ii) commutative property,
 - (iii) associative property
 - (iv) existence of identity and
 - (v) existence of inverse for the arithmetic operation + on $\mathbb{Z}$.
- 2) Verify the
 - (i) closure property,
 - (ii) commutative property,
 - (iii) associative property
 - (iv) existence of identity and
 - (v) existence of inverse for the arithmetic operation + on $\mathbb{Z}_e$ = the set of all even integers
- 3) How many rows are needed for following statement formulae?
 $p \vee \neg t (p \vee \neg s)$
- 4) Consider $p \rightarrow q$: If today is Monday, then $4 + 4 = 8$.
- 5) Construct the truth table for $(p \vee q) \wedge (p \vee \neg q)$
- 6) Establish the equivalence property $p \rightarrow q \equiv \neg p \vee q$
- 7) Let $A = \begin{pmatrix} 1 & 0 & 1 & 0 \\ 0 & 1 & 0 & 1 \\ 1 & 0 & 0 & 1 \end{pmatrix}$, $B = \begin{pmatrix} 0 & 1 & 0 & 1 \\ 1 & 0 & 1 & 0 \\ 1 & 0 & 0 & 1 \end{pmatrix}$, $C = \begin{pmatrix} 1 & 1 & 0 & 1 \\ 0 & 1 & 1 & 0 \\ 1 & 1 & 1 & 1 \end{pmatrix}$ be any three boolean matrices of the same type.
Find $A \vee B$
- 8) Let $A = \begin{pmatrix} 1 & 0 & 1 & 0 \\ 0 & 1 & 0 & 1 \\ 1 & 0 & 0 & 1 \end{pmatrix}$, $B = \begin{pmatrix} 0 & 1 & 0 & 1 \\ 1 & 0 & 1 & 0 \\ 1 & 0 & 0 & 1 \end{pmatrix}$, $C = \begin{pmatrix} 1 & 1 & 0 & 1 \\ 0 & 1 & 1 & 0 \\ 1 & 1 & 1 & 1 \end{pmatrix}$ be any three boolean matrices of the same type.
Find $(A \vee B) \wedge C$
- 9) Let $A = \begin{pmatrix} 1 & 0 & 1 & 0 \\ 0 & 1 & 0 & 1 \\ 1 & 0 & 0 & 1 \end{pmatrix}$, $B = \begin{pmatrix} 0 & 1 & 0 & 1 \\ 1 & 0 & 1 & 0 \\ 1 & 0 & 0 & 1 \end{pmatrix}$, $C = \begin{pmatrix} 1 & 1 & 0 & 1 \\ 0 & 1 & 1 & 0 \\ 1 & 1 & 1 & 1 \end{pmatrix}$ be any three boolean matrices of the same type.
Find $(A \wedge B) \vee C$
- 10) Verify whether the following compound propositions are tautologies or contradictions or contingency
 $((p \vee q) \wedge \neg p) \rightarrow q$
- 11) Show that
 $\neg(p \wedge q) \equiv \neg p \vee \neg q$

- 12) Show that $p \rightarrow q$ and $q \rightarrow p$ are not equivalent
- 13) Show that $\neg(p \leftrightarrow q) \equiv p \leftrightarrow \neg q$
- 14) Write the truth value for each of the following statements.
 - (1) $3 + 5 = 8$ and $\sqrt{2}$ is an irrational number.
 - (2) 5 is a positive integer or a square is a rectangle.
 - (3) Chennai is not in Tamilnadu.
- 15) Let $G = \{1, i, -1, -i\}$ under the binary operation multiplication. Find the inverse of all the elements.
- 16) Construct the truth table for $(\neg p) \vee (q \wedge r)$
- 17) The pair $(S, *)$ identify and inverse axioms, prove that $*$ is commutative if and only if $(a * b)^2 = a^a * b^2$.
- 18) Show that $(\mathbb{Z}_4, +_4)$ satisfies closure, associative and commutative properties.
- 19) In $(S, *)$ satisfying closure, associative, identity and inverse axioms and $(a * b)^{-1} = a^{-1} * b^{-1} \forall a, b \in S$, then prove that $*$ is commutative.
- 20) If $A = \begin{pmatrix} 1 & 1 \\ 1 & 0 \end{pmatrix}$, $B = \begin{pmatrix} 0 & 0 \\ 1 & 0 \end{pmatrix}$ and $C = \begin{pmatrix} 1 & 0 \\ 0 & 0 \end{pmatrix}$, find $(A \vee B) \vee C$

Ravi home tutions PH-8056206308**Discrete Mathematics 5M**

Date : 08-Nov-19

12th Standard

Maths

Reg.No. :

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Exam Time : 01:30:00 Hrs

Total Marks : 75

15 x 5 = 75

1) Write the statements in words corresponding to $\neg p$, $p \wedge q$, $p \vee q$ and $q \vee \neg p$, where p is 'It is cold' and q is 'It is raining.'

2) Verify

(i) closure property,

(ii) commutative property,

(iii) associative property,

(iv) existence of identity, and

(v) existence of inverse for following operation on the given set

$$m * n = m + n - mn; m, n \in \mathbb{Z}$$

3) How many rows are needed for following statement formulae?

$$p \vee \neg t (p \vee \neg s)$$

4) How many rows are needed for following statement formulae?

$$((p \wedge q) \vee (\neg r \vee \neg s)) \wedge (\neg t \wedge v)$$

5) Consider $p \rightarrow q$: If today is Monday, then $4 + 4 = 8$.

Here the component statements p and q are given by,

p: Today is Monday; q: $4 + 4 = 8$.

The truth value of $p \rightarrow q$ is T because the conclusion q is T.

An important point is that $p \rightarrow q$ should not be treated by actually considering the meanings of p and q in English. Also it is not necessary that p should be related to q at all.

Chapter

6) Write down the

(i) conditional statement

(ii) converse statement

(iii) inverse statement, and

(iv) contrapositive statement for the two statements p and q given below.

p: The number of primes is infinite.

q: Ooty is in Kerala.

7) Verify

(i) closure property,

(ii) commutative property,

(iii) associative property,

(iv) existence of identity, and

(v) existence of inverse for the operation $+_5$ on $\mathbb{Z}_5$ using table corresponding to addition modulo 5.

8) Verify

(i) closure property,

(ii) commutative property,

(iii) associative property,

(iv) existence of identity, and

- (v) existence of inverse for the operation $\times_{11}$ on a subset $A = \{1,3,4,5,9\}$ of the set of remainders $\{0,1,2,3,4,5,6,7,8,9,10\}$
- 9) Using the equivalence property, show that $p \leftrightarrow q \equiv (p \wedge q) \vee (\neg p \wedge \neg q)$
- 10) Define an operation $*$ on Q as follows: $a*b = \left(\frac{a+b}{2}\right)$; $a, b \in Q$. Examine the closure, commutative, and associative properties satisfied by $*$ on Q .
- 11) Define an operation $*$ on Q as follows: $a*b = \left(\frac{a+b}{2}\right)$; $a, b \in Q$. Examine the existence of identity and the existence of inverse for the operation $*$ on Q .
- 12) Let $M = \left\{ \begin{pmatrix} x & x \\ x & x \end{pmatrix} : x \in R - \{0\} \right\}$ and let $*$ be the matrix multiplication. Determine whether M is closed under $*$. If so, examine the commutative and associative properties satisfied by $*$ on M .
- 13) Let $M = \left\{ \begin{pmatrix} x & x \\ x & x \end{pmatrix} : x \in R - \{0\} \right\}$ and let $*$ be the matrix multiplication. Determine whether M is closed under $*$. If so, examine the existence of identity, existence of inverse properties for the operation $*$ on M .
- 14) Let A be $Q \setminus \{1\}$. Define $*$ on A by $x*y = x + y - xy$. Is $*$ binary on A ? If so, examine the commutative and associative properties satisfied by $*$ on A .
- 15) Let A be $Q \setminus \{1\}$. Define $*$ on A by $x*y = x + y - xy$. Is $*$ binary on A ? If so, examine the existence of identity, existence of inverse properties for the operation $*$ on A .

Discrete Mathematics

12th Standard

Maths

Exam Time : 02:00:00 Hrs

Total Marks : 75

15 x 5 = 75

- 1) Verify
 - (i) closure property,
 - (ii) commutative property,
 - (iii) associative property,
 - (iv) existence of identity, and
 - (v) existence of inverse for following operation on the given set
 $m * n = m + n - mn$; $m, n \in \mathbb{Z}$
- 2) Verify
 - (i) closure property,
 - (ii) commutative property,
 - (iii) associative property,
 - (iv) existence of identity, and
 - (v) existence of inverse for the operation $\times_{11}$ on a subset $A = \{1, 3, 4, 5, 9\}$ of the set of remainders $\{0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$
- 3) Define an operation $*$ on $\mathbb{Q}$ as follows: $a * b = \left(\frac{a+b}{2}\right)$; $a, b \in \mathbb{Q}$. Examine the closure, commutative, and associative properties satisfied by $*$ on $\mathbb{Q}$.
- 4) Define an operation $*$ on $\mathbb{Q}$ as follows: $a * b = \left(\frac{a+b}{2}\right)$; $a, b \in \mathbb{Q}$. Examine the existence of identity and the existence of inverse for the operation $*$ on $\mathbb{Q}$.
- 5) Verify whether the following compound propositions are tautologies or contradictions or contingency
 $((p \rightarrow q) \wedge (q \rightarrow r)) \rightarrow (p \rightarrow r)$
- 6) Let $M = \left\{ \begin{pmatrix} x & x \\ x & x \end{pmatrix} : x \in \mathbb{R} - \{0\} \right\}$ and let $*$ be the matrix multiplication. Determine whether M is closed under $*$. If so, examine the commutative and associative properties satisfied by $*$ on M .
- 7) Let A be $\mathbb{Q} \setminus \{1\}$. Define $*$ on A by $x * y = x + y - xy$. Is $*$ binary on A ? If so, examine the commutative and associative properties satisfied by $*$ on A .
- 8) Using truth table check whether the statements $\neg(p \vee q) \vee (\neg p \wedge q)$ and $\neg p$ are logically equivalent.
- 9) Let A be $\mathbb{Q} \setminus \{1\}$. Define $*$ on A by $x * y = x + y - xy$. Is $*$ binary on A ? If so, examine the existence of identity, existence of inverse properties for the operation $*$ on A .
- 10) Prove that $p \rightarrow (\neg q \vee r) \equiv \neg p \vee (\neg q \vee r)$ using truth table.
- 11) Construct the truth table for $(p \wedge q) \vee r$.
- 12) $M = \left\{ \begin{pmatrix} a & 0 \\ 0 & a \end{pmatrix} / a \neq 0 \text{ and } a \in \mathbb{R} \right\}$ Show that M satisfies the closure, associative, inverse, identity and commutative axioms under multiplication.
- 13) Show that $(\mathbb{Z}_7 - [0], \times_7)$ satisfies closure, identity, inverse and commutative properties.
- 14) Prove by using truth table $\sim (p \vee (q \vee r)) \equiv (\sim p) \wedge (\sim q \wedge \sim r)$

15) Prove without using the truth table $\sim (p \vee (q \vee r)) \equiv (\sim p \vee \sim q) \vee (\sim r)$

Ravi home tutions PH- 8056206308

Discrete Mathematics FULL TEST

Date : 08-Nov-19

12th Standard

Maths

Reg.No. :

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Exam Time : 02:30:00 Hrs

Total Marks : 90

20 x 1 = 20

- 1) A binary operation on a set S is a function from
 (a) $S \rightarrow S$ (b) $(S \times S) \rightarrow S$ (c) $S \rightarrow (S \times S)$ (d) $(S \times S) \rightarrow (S \times S)$
- 2) Subtraction is not a binary operation in
 (a) $\mathbb{R}$ (b) $\mathbb{Z}$ (c) $\mathbb{N}$ (d) $\mathbb{Q}$
- 3) Which one of the following is a binary operation on $\mathbb{N}$?
 (a) Subtraction (b) Multiplication (c) Division (d) All the above
- 4) In the set $\mathbb{R}$ of real numbers '*' is defined as follows. Which one of the following is not a binary operation on $\mathbb{R}$?
 (a) $a*b = \min(a, b)$ (b) $a*b = \max(a, b)$ (c) $a*b = a$ (d) $a*b = a^b$
- 5) The operation * defined by $a*b = \frac{ab}{7}$ is not a binary operation on
 (a) $\mathbb{Q}^+$ (b) $\mathbb{Z}$ (c) $\mathbb{R}$ (d) $\mathbb{C}$
- 6) In the set $\mathbb{Q}$ define $a \odot b = a + b + ab$. For what value of y, $3 \odot (y \odot 5) = 7$?
 (a) $y = \frac{2}{3}$ (b) $y = -\frac{2}{3}$ (c) $y = -\frac{3}{2}$ (d) $y = 4$
- 7) If $a*b = \sqrt{a^2 + b^2}$ on the real numbers then * is
 (a) commutative but not associative (b) associative but not commutative (c) both commutative and associative (d) neither commutative nor associative
- 8) Which one of the following statements has the truth value T?
 (a) $\sin x$ is an even function (b) Every square matrix is non-singular (c) The product of complex number and its conjugate is purely imaginary (d) $\sqrt{5}$ is an irrational number
- 9) Which one of the following statements has truth value F?
 (a) Chennai is in India or $\sqrt{2}$ is an integer (b) Chennai is in India or $\sqrt{2}$ is an irrational number (c) Chennai is in China or $\sqrt{2}$ is an integer (d) Chennai is in China or $\sqrt{2}$ is an irrational number
- 10) If a compound statement involves 3 simple statements, then the number of rows in the truth table is
 (a) 9 (b) 8 (c) 6 (d) 3
- 11) Which one is the inverse of the statement $(p \vee q) \rightarrow (p \wedge q)$?
 (a) $(p \wedge q) \rightarrow (p \vee q)$ (b) $\neg(p \vee q) \rightarrow (p \wedge q)$ (c) $(\neg p \vee \neg q) \rightarrow (\neg p \wedge \neg q)$ (d) $(\neg p \wedge \neg q) \rightarrow (\neg p \vee \neg q)$
- 12) Which one is the contrapositive of the statement $(p \vee q) \rightarrow r$?
 (a) $\neg r \rightarrow (\neg p \wedge \neg q)$ (b) $\neg r \rightarrow (p \vee q)$ (c) $r \rightarrow (p \wedge q)$ (d) $p \rightarrow (q \vee r)$
- 13) The truth table for $(p \wedge q) \vee \neg q$ is given below

p	q	$(p \wedge q) \vee (\neg q)$
T	T	(a)
T	F	(b)
F	T	(c)
F	F	(d)

Which one of the following is true?

(a)

(a)	(b)	(c)	(d)
T	T	T	T

(b)

(a)	(b)	(c)	(d)
T	F	T	T

(c)

(a)	(b)	(c)	(d)
T	T	F	F

(d)

(a)	(b)	(c)	(d)
T	F	F	F

- 14) In the last column of the truth table for $\neg(p \vee \neg q)$ the number of final outcomes of the truth value 'F' are
 (a) 1 (b) 2 (c) 3 (d) 4

- 15) Which one of the following is incorrect? For any two propositions p and q, we have

(a) $\neg(p \vee q) \equiv \neg p \wedge \neg q$

(b) $\neg(p \wedge q) \equiv \neg p \vee \neg q$

(c) $\neg(p \vee q) \equiv \neg p \vee \neg q$

(d) $\neg(\neg p) \equiv p$

- 16)

p	q	$(p \wedge q) \rightarrow \neg q$
T	T	(a)
T	F	(b)

F	T	(c)
F	F	(d)

Which one of the following is correct for the truth value of $(p \wedge q) \rightarrow \neg p$?

(a)

(a)	(b)	(c)	(d)
T	T	T	T

(b)

(a)	(b)	(c)	(d)
F	T	T	T

(c)

(a)	(b)	(c)	(d)
F	F	T	T

(d)

(a)	(b)	(c)	(d)
T	T	T	F

17) The dual of $\neg(p \vee q) \vee [p \vee (p \wedge \neg r)]$ is

- (a) $\neg(p \wedge q) \wedge [p \vee (p \wedge \neg r)]$ (b) $(p \wedge q) \wedge [p \wedge (p \vee \neg r)]$ (c) $\neg(p \wedge q) \wedge [p \wedge (p \wedge r)]$ (d) $\neg(p \wedge q) \wedge [p \wedge (p \vee \neg r)]$

18) The proposition $p \wedge (\neg p \vee q)$ is

- (a) a tautology (b) a contradiction (c) logically equivalent to $p \wedge q$ (d) logically equivalent to $p \vee q$

19) Determine the truth value of each of the following statements:

- (a) $4+2=5$ and $6+3=9$
 (b) $3+2=5$ and $6+1=7$
 (c) $4+5=9$ and $1+2=4$
 (d) $3+2=5$ and $4+7=11$

(a)

(a)	(b)	(c)	(d)
F	T	T	T

(b)

(a)	(b)	(c)	(d)
T	F	T	F

(c)

(a)	(b)	(c)	(d)
T	T	F	F

(d)

(a)	(b)	(c)	(d)
F	F	T	T

20) Which one of the following is not true?

- (a) Negation of a negation of a statement is the statement itself (b) If the last column of the truth table contains only T then it is a tautology. (c) If the last column of its truth table contains only F then it is a contradiction (d) If p and q are any two statements then $p \leftrightarrow q$ is a tautology.

$$7 \times 2 = 14$$

21) Examine the binary operation (closure property) of the following operations on the respective sets (if it is not, make it binary)

$$a * b = \left(\frac{a-1}{b-1}\right), \forall a, b \in Q$$

22) Let $A = \begin{bmatrix} 0 & 1 \\ 1 & 1 \end{bmatrix}$, $B = \begin{bmatrix} 1 & 1 \\ 0 & 1 \end{bmatrix}$ be any two boolean matrices of the same type. Find $A \vee B$ and $A \wedge B$.

23) Write the converse, inverse, and contrapositive of each of the following implication.

- (i) If x and y are numbers such that $x = y$, then $x^2 = y^2$
 (ii) If a quadrilateral is a square then it is a rectangle.

24) Verify whether the following compound propositions are tautologies or contradictions or contingency

$$((p \vee q) \wedge \neg p) \rightarrow q$$

25) Verify whether the following compound propositions are tautologies or contradictions or contingency

$$((p \rightarrow q) \wedge (q \rightarrow r)) \rightarrow (p \rightarrow r)$$

26) Check whether the statement $p \rightarrow (q \rightarrow p)$ is a tautology or a contradiction without using the truth table.

27) Prove that $p \rightarrow (\neg q \vee r) \equiv \neg p \vee (\neg q \vee r)$ using truth table.

$$7 \times 3 = 21$$

28) Determine whether * is a binary operation on the sets given below.

$$a * b = a \cdot |b| \text{ on } R$$

29) Determine whether * is a binary operation on the sets given below.

$$(A * v) = a \sqrt{b} \text{ is binary on } R$$

30) Let * be defined on R by $(a * b) = a + b + ab - 7$. is * binary on R? If so, find $3\left(\frac{-7}{15}\right)$.

31) Let $A = \{a + \sqrt{5}b : a, b \in Z\}$. Check whether the usual multiplication is a binary operation on A.

32)

Consider the binary operation $*$ defined on the set $A = \{a, b, c, d\}$ by the following table:

*	a	b	c	d
a	a	a	c	b
b	c	d	a	a
d	d	b	a	c

Is it commutative and associative?

- 33) Let $A = \begin{pmatrix} 1 & 0 & 1 & 0 \\ 0 & 1 & 0 & 1 \\ 1 & 0 & 0 & 1 \end{pmatrix}$, $B = \begin{pmatrix} 0 & 1 & 0 & 1 \\ 1 & 0 & 1 & 0 \\ 1 & 0 & 0 & 1 \end{pmatrix}$, $C = \begin{pmatrix} 1 & 1 & 0 & 1 \\ 0 & 1 & 1 & 0 \\ 1 & 1 & 1 & 1 \end{pmatrix}$ be any three boolean matrices of the same type.

Find $A \wedge B$

- 34) Let $A = \begin{pmatrix} 1 & 0 & 1 & 0 \\ 0 & 1 & 0 & 1 \\ 1 & 0 & 0 & 1 \end{pmatrix}$, $B = \begin{pmatrix} 0 & 1 & 0 & 1 \\ 1 & 0 & 1 & 0 \\ 1 & 0 & 0 & 1 \end{pmatrix}$, $C = \begin{pmatrix} 1 & 1 & 0 & 1 \\ 0 & 1 & 1 & 0 \\ 1 & 1 & 1 & 1 \end{pmatrix}$ be any three boolean matrices of the same type.

Find $(A \wedge B) \vee C$

7 x 5 = 35

- 35) How many rows are needed for following statement formulae?

$((p \wedge q) \vee (\neg r \vee \neg s)) \wedge (\neg t \wedge v)$

- 36) Consider $p \rightarrow q$: If today is Monday, then $4 + 4 = 8$.

Here the component statements p and q are given by,

p : Today is Monday; q : $4 + 4 = 8$.

The truth value of $p \rightarrow q$ is T because the conclusion q is T.

An important point is that $p \rightarrow q$ should not be treated by actually considering the meanings of p and q in English. Also it is not necessary that p should be related to q at all.

Chapter

- 37) Write down the

(i) conditional statement

(ii) converse statement

(iii) inverse statement, and

(iv) contrapositive statement for the two statements p and q given below.

p : The number of primes is infinite.

q : Ooty is in Kerala.

- 38) Construct the truth table for $(p \vee q) \wedge (p \vee \neg q)$

- 39) Define an operation $*$ on Q as follows: $a * b = (\frac{a+b}{2})$; $a, b \in Q$. Examine the closure, commutative, and associative properties satisfied by $*$ on Q .

- 40) Define an operation $*$ on Q as follows: $a * b = (\frac{a+b}{2})$; $a, b \in Q$. Examine the existence of identity and the existence of inverse for the operation $*$ on Q .

- 41) Let A be $Q \setminus \{1\}$. Define $*$ on A by $x * y = x + y - xy$. Is $*$ binary on A ? If so, examine the commutative and associative properties satisfied by $*$ on A .

Discrete Mathematics FULL TEST

12th Standard

Maths

Reg.No. :

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Exam Time : 03:00:00 Hrs

Total Marks : 90

ANSWER ALL THE QUESTIONS.

20 x 1 = 20

- 1) A binary operation on a set S is a function from
 (a) $S \rightarrow S$ (b) $(S \times S) \rightarrow S$ (c) $S \rightarrow (S \times S)$ (d) $(S \times S) \rightarrow (S \times S)$
- 2) Subtraction is not a binary operation in
 (a) R (b) Z (c) N (d) Q
- 3) Which one of the following is a binary operation on N?
 (a) Subtraction (b) Multiplication (c) Division (d) All the above
- 4) In the set R of real numbers '*' is defined as follows. Which one of the following is not a binary operation on R?
 (a) $a*b = \min(a, b)$ (b) $a*b = \max(a, b)$ (c) $a*b = a$ (d) $a*b = a^b$
- 5) The operation * defined by $a*b = \frac{ab}{7}$ is not a binary operation on
 (a) Q^+ (b) Z (c) R (d) C
- 6) In the set Q define $a \odot b = a + b + ab$. For what value of y, $3 \odot (y \odot 5) = 7$?
 (a) $y = \frac{2}{3}$ (b) $y = \frac{-2}{3}$ (c) $y = \frac{-3}{2}$ (d) $y = 4$
- 7) If $a*b = \sqrt{a^2 + b^2}$ on the real numbers then * is
 (a) commutative but not associative (b) associative but not commutative (c) both commutative and associative (d) neither commutative nor associative
- 8) Which one of the following statements has the truth value T?
 (a) $\sin x$ is an even function (b) Every square matrix is non-singular (c) The product of complex number and its conjugate is purely imaginary (d) $\sqrt{5}$ is an irrational number
- 9) Which one of the following statements has truth value F?
 (a) Chennai is in India (b) Chennai is in India or $\sqrt{2}$ is an integer (c) Chennai is in China or $\sqrt{2}$ is an irrational number (d) Chennai is in China or $\sqrt{2}$ is an integer or $\sqrt{2}$ is an irrational number
- 10) If a compound statement involves 3 simple statements, then the number of rows in the truth table is
 (a) 9 (b) 8 (c) 6 (d) 3
- 11) Which one is the inverse of the statement $(P \vee Q) \rightarrow (P \wedge Q)$?
 (a) $(P \wedge Q) \rightarrow (P \vee Q)$ (b) $\neg(P \vee Q) \rightarrow (P \wedge Q)$ (c) $(\neg P \vee \neg Q) \rightarrow (\neg P \wedge \neg Q)$ (d) $(\neg P \wedge \neg Q) \rightarrow (\neg P \vee \neg Q)$
- 12) Which one is the contrapositive of the statement $(P \vee Q) \rightarrow r$?
 (a) $\neg r \rightarrow (\neg P \wedge \neg Q)$ (b) $\neg r \rightarrow (P \vee Q)$ (c) $r \rightarrow (P \wedge Q)$ (d) $p \rightarrow (q \vee r)$
- 13) The truth table for $(p \wedge q) \vee \neg q$ is given below

p	q	$(p \wedge q) \vee (\neg q)$
T	T	(a)
T	F	(b)
F	T	(c)
F	F	(d)

Which one of the following is true?

(a)

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(b)

--	--	--	--

(c)

--	--	--	--

(d)

--	--	--	--

T	T	T	T
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T	F	T	T
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T	T	F	F
---	---	---	---

T	F	F	F
---	---	---	---

- 14) In the last column of the truth table for $\neg(p \vee \neg q)$ the number of final outcomes of the truth value 'F' are
 (a) 1 (b) 2 (c) 3 (d) 4

- 15) Which one of the following is incorrect? For any two propositions p and q, we have

- (a) $\neg(p \vee q) \equiv \neg p \wedge \neg q$ (b) $\neg(p \wedge q) \equiv \neg p \vee \neg q$ (c) $\neg(p \vee q) \equiv \neg p \vee \neg q$ (d) $\neg(\neg p) \equiv p$

16)

p	q	$(p \wedge q) \rightarrow \neg q$
T	T	(a)
T	F	(b)
F	T	(c)
F	F	(d)

Which one of the following is correct for the truth value of $(p \wedge q) \rightarrow \neg p$?

(a)

(a)	(b)	(c)	(d)
T	T	T	T

(b)

(a)	(b)	(c)	(d)
F	T	T	T

(c)

(a)	(b)	(c)	(d)
F	F	T	T

(d)

(a)	(b)	(c)	(d)
T	T	T	F

- 17) The dual of $\neg(p \vee q) \vee [p \vee (p \wedge \neg r)]$ is

- (a) $\neg(p \wedge q) \wedge [p \vee (p \wedge \neg r)]$ (b) $(p \wedge q) \wedge [p \wedge (p \vee \neg r)]$ (c) $\neg(p \wedge q) \wedge [p \wedge (p \wedge \neg r)]$ (d) $\neg(p \wedge q) \wedge [p \wedge (p \vee \neg r)]$

- 18) The proposition $p \wedge (\neg p \vee q)$ is

- (a) a tautology (b) a contradiction (c) logically equivalent to $p \wedge q$ (d) logically equivalent to $p \vee q$

- 19) Determine the truth value of each of the following statements:

- (a) $4+2=5$ and $6+3=9$
 (b) $3+2=5$ and $6+1=7$
 (c) $4+5=9$ and $1+2=4$
 (d) $3+2=5$ and $4+7=11$

(a)

(a)	(b)	(c)	(d)
F	T	T	T

(b)

(a)	(b)	(c)	(d)
T	F	T	F

(c)

(a)	(b)	(c)	(d)
T	T	F	F

(d)

(a)	(b)	(c)	(d)
F	F	T	T

- 20) Which one of the following is not true?

- (a) Negation of a negation of a statement the truth table contains only T then it is a tautology.
 (b) If the last column of the truth table contains only F then it is a contradiction.
 (c) If the last column of its truth table contains only F then it is a contradiction.
 (d) If p and q are any two statements then $p \leftrightarrow q$ is a tautology.

Answer any 7 questions in which question no. 30 is compulsory

7 x 2 = 14

- 21) Examine the binary operation (closure property) of the following operations on the respective sets (if it is not, make it binary)

$$a * b = \left(\frac{a-1}{b-1} \right), \forall a, b \in Q$$

- 22) Let $A = \begin{bmatrix} 0 & 1 \\ 1 & 1 \end{bmatrix}$, $B = \begin{bmatrix} 1 & 1 \\ 0 & 1 \end{bmatrix}$ be any two boolean matrices of the same type. Find $A \vee B$ and $A \wedge B$.

- 23) Write the converse, inverse, and contrapositive of each of the following implication.

- (i) If x and y are numbers such that $x = y$, then $x^2 = y^2$
 (ii) If a quadrilateral is a square then it is a rectangle.

- 24) Verify whether the following compound propositions are tautologies or contradictions or contingency

$$((p \vee q) \wedge \neg p) \rightarrow q$$

- 25) Verify whether the following compound propositions are tautologies or contradictions or contingency
 $((p \rightarrow q) \wedge (q \rightarrow r)) \rightarrow (p \rightarrow r)$
- 26) Check whether the statement $p \rightarrow (q \rightarrow p)$ is a tautology or a contradiction without using the truth table.
- 27) Prove that $p \rightarrow (\neg q \vee r) \equiv \neg p \vee (\neg q \vee r)$ using truth table.
- 28) Show that $p \vee (q \wedge r)$ is a contingency.
- 29) In the set of integers under the operation $*$ defined by $a * b = a + b - 1$. Find the identity element.
- 30) Let S be the set of positive rational numbers and is defined by $a * b = \frac{ab}{2}$. Then find the identity element and the inverse of 2.

Answer any 7 questions in which question no. 40 is compulsory

7 x 3 = 21

- 31) Determine whether $*$ is a binary operation on the sets given below.

$$a * b = a \cdot |b| \text{ on } \mathbb{R}$$

- 32) Determine whether $*$ is a binary operation on the sets given below.

$$(A * v) = a \vee b \text{ is binary on } \mathbb{R}$$

- 33) Let $*$ be defined on $\mathbb{R}$ by $(a * b) = a + b + ab - 7$. is $*$ binary on $\mathbb{R}$? If so, find $3 \left(\frac{-7}{15} \right)$.

- 34) Let $A = \{a + \sqrt{5} \mid b : a, b \in \mathbb{Z}\}$. Check whether the usual multiplication is a binary operation on A .

- 35) Consider the binary operation $*$ defined on the set $A = \{a, b, c, d\}$ by the following table:

*	a	b	c	d
a	a	a	b	d
b	c	d	a	a
d	d	b	a	c

Is it commutative and associative?

- 36) Let $A = \begin{pmatrix} 1 & 0 & 1 & 0 \\ 0 & 1 & 0 & 1 \\ 1 & 0 & 0 & 1 \end{pmatrix}, B = \begin{pmatrix} 0 & 1 & 0 & 1 \\ 1 & 0 & 1 & 0 \\ 1 & 0 & 0 & 1 \end{pmatrix}, C = \begin{pmatrix} 1 & 1 & 0 & 1 \\ 0 & 1 & 1 & 0 \\ 1 & 1 & 1 & 1 \end{pmatrix}$ be any three

boolean matrices of the same type.

Find $A \wedge B$

- 37) Let $A = \begin{pmatrix} 1 & 0 & 1 & 0 \\ 0 & 1 & 0 & 1 \\ 1 & 0 & 0 & 1 \end{pmatrix}, B = \begin{pmatrix} 0 & 1 & 0 & 1 \\ 1 & 0 & 1 & 0 \\ 1 & 0 & 0 & 1 \end{pmatrix}, C = \begin{pmatrix} 1 & 1 & 0 & 1 \\ 0 & 1 & 1 & 0 \\ 1 & 1 & 1 & 1 \end{pmatrix}$ be any three

boolean matrices of the same type.

Find $(A \wedge B) \vee C$

- 38) In $(\mathbb{Z}, *)$ where $*$ is defined by $a * b = ab$, prove that $*$ is not a binary operation on $\mathbb{Z}$.
- 39) Let $G = \{1, i, -1, -i\}$ under the binary operation multiplication. Find the inverse of all the elements.
- 40) In $(\mathbb{Z}, *)$ where $*$ is defined as $a * b = a + b + 2$. Verify the commutative and associative axiom.

ANSWER 7 QUESTIONS.

7 x 5 = 35

- 41) How many rows are needed for following statement formulae?

$$((p \wedge q) \vee (\neg r \vee \neg s)) \wedge (\neg t \wedge v)$$

- 42) Consider $p \rightarrow q$: If today is Monday, then $4 + 4 = 8$.

Here the component statements p and q are given by,

p : Today is Monday; q : $4 + 4 = 8$.

The truth value of $p \rightarrow q$ is T because the conclusion q is T.

An important point is that $p \rightarrow q$ should not be treated by actually considering the meanings of p and q in English. Also it is not necessary that p should be related to q at all.

Chapter

- 43) Construct the truth table for $(p \vee q) \wedge (p \vee \neg q)$
- 44) Define an operation * on Q as follows: $a * b = \left(\frac{a+b}{2}\right)$; $a, b \in Q$. Examine the closure, commutative, and associative properties satisfied by * on Q.
- 45) Define an operation * on Q as follows: $a * b = \left(\frac{a+b}{2}\right)$; $a, b \in Q$. Examine the existence of identity and the existence of inverse for the operation * on Q.
- 46) Let A be $Q \setminus \{1\}$. Define * on A by $x * y = x + y - xy$. Is * binary on A? If so, examine the commutative and associative properties satisfied by * on A.
- 47) Verify
- (i) closure property,
 - (ii) commutative property,
 - (iii) associative property,
 - (iv) existence of identity, and
 - (v) existence of inverse for following operation on the given set
- $m * n = m + n - mn$; $m, n \in Z$
- 48) Verify
- (i) closure property,
 - (ii) commutative property,
 - (iii) associative property,
 - (iv) existence of identity, and
 - (v) existence of inverse for the operation $+_5$ on Z_5 using table corresponding to addition modulo 5.
- 49) Let $M = \left\{ \begin{pmatrix} x & x \\ x & x \end{pmatrix} : x \in R - \{0\} \right\}$ and let * be the matrix multiplication. Determine whether M is closed under *. If so, examine the existence of identity, existence of inverse properties for the operation * on M.
- 50) Let A be $Q \setminus \{1\}$. Define * on A by $x * y = x + y - xy$. Is * binary on A? If so, examine the existence of identity, existence of inverse properties for the operation * on A.

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