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MP – Vyapam

Sub Engineer

Madhya Pradesh Employees Selection Board (MP ESB)

Volume - 1

NON - TECHNICAL

Reasoning, General Maths and Computer

SIERRA INNOVATIONS

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1 CHAPTER Series

The series test series has to be studied carefully to find out whether this series is following the order/rule or not.

The questions asked under this test can be classified into the following categories.

1. Digit series
2. Alphabet series
3. Frequency Series of Digits/Characters

There are a few things to keep in mind while doing chain test.

A. First try to play the whole chain.
B. If the chain does not work, then we run it by laughing.
C. At the very end run the alternate series

1. Digit series -

In this, a series of marks is given in the questions asked. This series is based on addition, subtraction, multiplication, division, square, square root, cube, cube root etc.

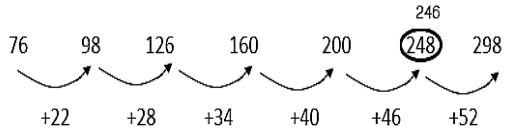
Type - (i) Finding the wrong term in the series.

In the series sequence, a wrong digit is added in place of the digit appearing at a particular place. For this, first of all it should be known that which term is not changing according to that rule, that is the wrong term.

Ex.1 Which number is missing in the following number series?
76, 98, 126, 160, 200, 248, 298
(A) 248 (B) 200
(C) 160 (D) 298

Ans. (A)

Sol. After observing the above series carefully, we find that the sixth term of the series is inappropriate
Because the number to be added to each term is 6 digits more than its first number.

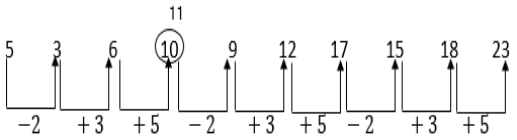


So instead of 248, there will be 246.

Ex.2 Which number in the following series is such that it is inappropriate in the series?
5, 3, 6, 10, 9, 12, 17, 15, 18, 23
(A) 6 (B) 9
(C) 12 (D) 10

Ans. (D)

Sol. After observing the above series carefully, we find that the series is decreasing and increasing in the order of -2, +3, +5, -2, +3, +5 ……



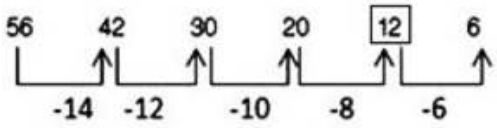
In the above series, 11 should come after the digit '6'. Hence the wrong number in the series is 10.

Directions: Question (1-7) Find the missing number in the following series.

Q.1 56, 42, 30, 20, ?, 6
(A) 15 (B) 12
(C) 18 (D) 14

Ans. (B)

Explanation-



So, ? = 12

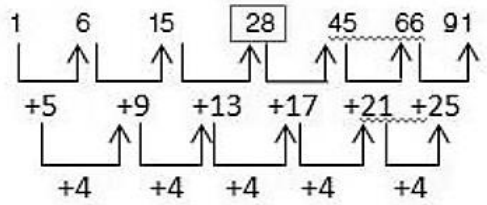
Q.2 1, 6, 15, ?, 45, 66, 91

(A) 25 (B) 26

(C) 27 (D) 28

Ans. (D)

Explanation-



So, ? = 28

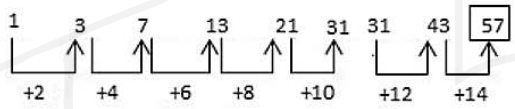
Q.3 1, 3, 7, 13, 21, 31, 43, ?

(A) 55 (B) 57

(C) 59 (D) 61

Ans. (B)

Explanation-



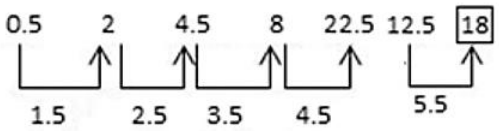
So, ? = 57

Q.4 0.5, 2, 4.5, 8, 12.5, ?

(A) 17 (B) 16

(C) 16.5 (D) 18

Ans. (D)



Explanation-

So, ? = 18

Q.5 3, 6, 18, 21, 63, 66, ?

(A) 181 (B) 160

(C) 147 (D) 198

Ans. (D)

Explanation-

3 + 3 = 6, 6 × 3 = 18

18 + 3 = 21, 21 x 3 = 63

So, 63 + 3 = 66

? = 66 × 3 =198

Q.6 510, 322, 404, ?

(A) 422 (B) 371

(C) 629 (D) 819

Ans. (A)

Explanation –

There are even numbers in the sequence.

So, ? = 422

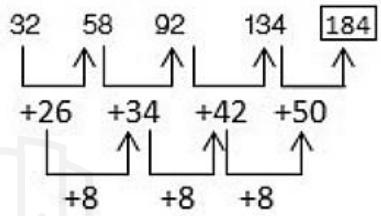
Q.7 32, 58, 92, 134, ?

(A) 184 (B) 194

(C) 156 (D) 169

Ans. (A)

Explanation-



So, ? = 184

Type – (II)

Completing the series -

Under this, in the given series sequence, a particular place is left blank or is denoted by the question mark (?), then the candidates are expected to find that sequence and mark the question mark (?). Select the appropriate number to come in place of.

Ex.3 Which of the given number will come in place of question mark in the series?

16, 23, 31, 40, 50, 61, ?

(A) 81 (B) 83

(C) 77 (D) 73

Ans. (D)

Sol. On observing the above series, we find that the series is increasing in the order of +7,+8,+9,+10…….

Therefore, the appropriate number to come in place of the question mark will be 73.

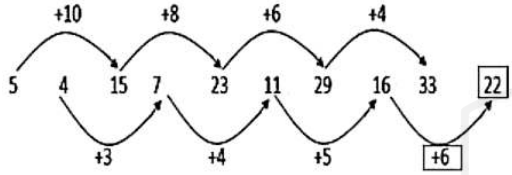
Ex.4 Which number will come in the question place in the above series?

5a 4a 15a 7a 23a 11a 29a 16a 33a g

(a) 11 (b) 22

(b) 29 (d) 34

Ans. (B)



Therefore, the appropriate number to come in place of the question mark will be 22.

Type – III based on series rule

There are 2 types of rules of the category based on the rule of the first category.

1. Arithmetic series
2. Geometric series

1. Arithmetic Series - An arithmetic series is called a series in which the difference of two consecutive terms is equal.

The number obtained by subtracting the preceding term from a term of an A.P. is called 'transition'.

If there is the first post of the parallel category and the post is of the post, then there will be an parallel category.

Hence the nth term of the A.P. $T_n = a + (n-d)$ (1) d (where, a is the first term and d is the transition)

Ex.5 What will be the 10th term of 1st series 3, 5, 7, 9……

(A) 15 (B) 20

(C) 12 (D) 21

Ans. (D)

Sol. 10th term

Tn = a + (n-1) d

T10 = 3 + (10 − 1) × 2

T10 = 3 + 18

T10 = 21

Hence the 10th term is 21

Ex.6 If the first term of an arithmetic sequence is 5, the second term is 3 and the last term is 80, then find the number of terms.

(A) 24 (B) 23

(C) 26 (D) 29

Ans. (C)

Sol. a = 5, d = 3, Tn = 80, n = ?

Tn = a + (n − 1)d

80 = 5 + (n − 1) 3

(n − 1) =80 − 5/3

n − 1 = 25

n = 25 + 1

n = 26

Hence the number of posts is 26

2. Geometric Series - Such a series in which the ratio of two consecutive terms is same is called 'Geometric Series'.

This ratio is called the 'common ratio' of the geometric series. The 'common ratio' of a geometric series is obtained by dividing a term by its previous term, i.e.

t2/t1=t3/t2=t4/t3= ⋯ ... ...

=tn/tn−1=proportionate

t1,t2,t3,t4

The middle term is the average of both the terms.

t2 − t1 = t3 − t2 = t4 − t3

If the first term of a geometric series is a and the proportion is r, then the nTH term of that geometric series

Tn = a. r^n−1

Ex.7 What is the 6th term of the series 3,9,27,81,.....?

(A) 729 (B) 243

(C) 1681 (D) 1747

Ans. (A)

Sol. First Term a = 3

Common ratio d=9/3=3

6th termT6 = a. r^n−1

= 3. 3^6 − 1

= 3 × 3^5

= 3 × 243 = 729

= 3 × 243 = 729

So the 6th term is 729

Ex.8 What will be the 10th term of the series 7, 14, 28,..... ?

(A) 3216 (B) 2736

(C) 2684 (D) 3584

Ans. (D)

Sol. First Term a=7

Common ratio=14/7=2

10th term

T10 = a. r^n−1

= 7 × 2^10−1

= 7 × 2^9

= 7 × 512

= 3584

Hence the 10th term is 3584

Type-IV

Q.1 In the following questions, select the odd number pair from the given alternatives.

(A) 10.30 (B) 11.33

(C) 50.150 (D) 13.37

Ans. (D)

Explanation-

Except the number pair 13-37, in all the other number-pairs, the second number is three times the first number.

10 × 3 = 30

11 × 3 = 33

50 × 3 = 150

but,

13 × 3 – 2 = 37

Q.2 In the following questions, select the odd number pair from the given alternatives.

(A) 18 : 37 (B) 24 : 47

(C) 32 : 65 (D) 48 : 97

Ans. (B)

Explanation-

Number pair 24: Except 47, in all other number-pairs, the second number is one more than twice the first number.

18 × 21= 37

32 × 21 =65

48 × 21= 97

but,

24 × 2-1=47

3. Alphabet series -

Under this, a series of letters related to the English alphabet is given in the given series, in which one or two letters are omitted, or is represented by a question mark (?) in that place.

Ex.9 What will come in place of question mark (?) in the given series?

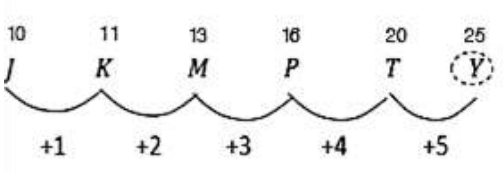
J K M P T ?

(A) X (B) W

(C) Y (D) none

Ans. (C)

Sol.



Hence the appropriate letter coming in place of question mark (?) will be Y.

Ex.10 L7C, N9F, P12I, R16L, ? What will come at the question mark in this series?

(A) U21O (B) S21P

(C) S20O (D) T21O

Ans. (D)

Sol. Therefore, in place of the question mark (?), the appropriate number-letter group will beT21O.

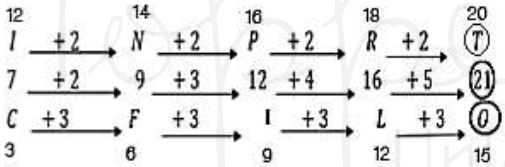
Ex.11 What will come in place of the missing letters of the following series?

ab___baabc___aabcb____abcb__

(A) bcaa (B) cbaa

(C) abca (D) aacb

Ans. (B)



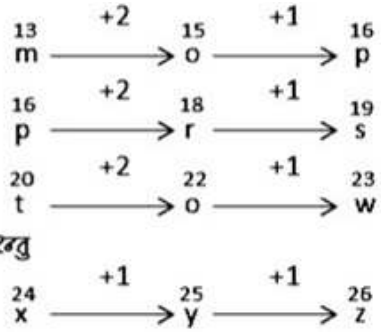
Q.1 In the following question, select the odd letters from the given alternatives.

(A) mop (B) prs

(C) tvw (D) xyz

Ans. (D)

Explanation-



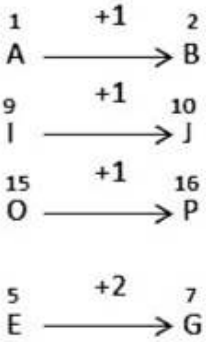
Q.2 In the following questions, select the odd letters from the given alternatives.

(A) AB (B) EG

(C) IJ (D) OP

Ans. (B)

Explanation-



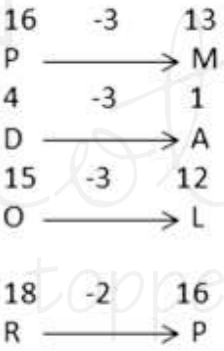
Q.3 In the following questions, select the odd letters from the given alternatives.

(A) PM (B) DA

(C) RP (D) OL

Ans. (C)

Explanation -



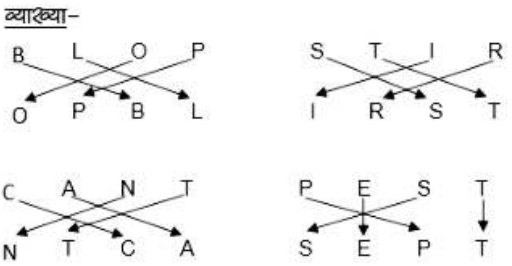
Q.4 In the following questions, select the odd letters from the given alternatives.

(A) BLOP-OPBL (B) STIR-IRST

(C) CANT-NTCA (D) PEST-SEPT

Ans. (D)

Explanation-



Q.5 In the following questions, select the odd letters from the given alternatives.

(A) EI-LM (B) AE-RT

(C) IO-WY (D) OU-DF

Ans. (A)

Explanation –

'Letter-pair' is a letter gap between the letters of the second unit in all other letter-pairs except 'EI-LM'. The first unit has a continuous vowel.

AE $\xrightarrow{+2}$ R $\xrightarrow{+2}$ T

IO $\xrightarrow{+2}$ W $\xrightarrow{+2}$ Y

OU $\xrightarrow{+2}$ D $\xrightarrow{+2}$ F

परन्तु

EI $\xrightarrow{+1}$ L $\xrightarrow{+1}$ M

Q.6 In the following questions, select the odd letters from the given alternatives.

(A) DEGJ (B) QRTW

(C) YZBE (D) JKNQ

Ans. (D)

Explanation -

$D \xrightarrow{+1} E \xrightarrow{+2} G \xrightarrow{+3} J$

$Q \xrightarrow{+1} R \xrightarrow{+2} T \xrightarrow{+3} W$

$Y \xrightarrow{+1} Z \xrightarrow{+2} B \xrightarrow{+3} E$

परन्तु

$J \xrightarrow{+1} K \xrightarrow{+3} N \xrightarrow{+3} Q$

Q.7 In the following questions, select the odd letters from the given alternatives.

(A) ACDF (B) TUOP

(C) HIVW (D) FGKL

Ans. (A)

Explanation -

$A \xrightarrow{+2} C ; D \xrightarrow{+2} F$

$T \xrightarrow{+1} U ; D \xrightarrow{+1} P$

$H \xrightarrow{+1} I ; V \xrightarrow{+1} W$

$F \xrightarrow{+1} G ; K \xrightarrow{+1} L$

3. Frequency series of digits or letters -

Under this, the numbers or letters appear repeatedly in a certain sequence, thus forming a series of numbers / letters in which one or two digits in the middle or end or

Alphabets are lost and candidates have to find out the missing number/letters.

Ex.12 0248750300102487503001O

(A) 2,4 (B) 0,1

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

Ans. (A)

Sol. After looking carefully at the given series of numbers, we find that 02487503001 is appearing repeatedly in the sequence.

So the next two digits will be 2 and 4.

Directions: (1-7) Find the missing term in the following series-

Q.1 Y, S, N, J, G, ?

(A) F (B) E

(C) H (D) I

Ans. (B)

Explanation-

Hence, the appropriate term coming in place of (?) will be E.

Q.2 NZ, OY, PX, QW, RV, ?

(A) FS (B) SU

(C) UF (D) TU

Ans. (B)

Explanation-

Hence, the appropriate term will come in place of (?) will be SU.

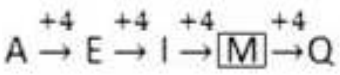
Q.3 A, E, I, ?, Q

(A) O (B) M

(C) U (D) L

Ans. (B)

Explanation-



Hence, the appropriate term to come in place of (?) will be M.

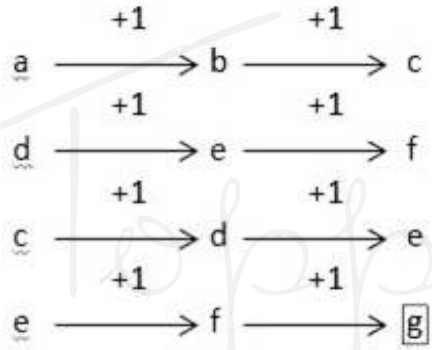
Q.4 a d c e b e d f c f e ?

(A) h (B) g

(C) f (D) d

Ans. (B)

Explanation-



Hence, the appropriate term coming in place of (?) would be g.

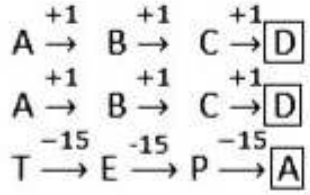
Q.5 AAT, BBE, CCP, ?

(A) DDA (B) DDB

(C) DDC (D) DDD

Ans. (A)

Explanation-



Hence, the appropriate term to come in place of (?) will be DDA

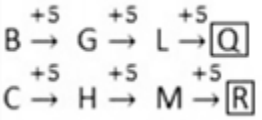
Q.6 BC, GH, LM, ?

(A) PQ (B) RS

(C) QR (D) OP

Ans. (C)

Explanation-



Therefore, the appropriate term that comes in place of (?) will be QR.

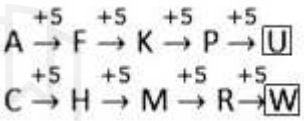
Q.7 AC, FH, KM, PR, ?

(A) UX (B) TV

(C) UW (D) VW

Ans. (C)

Explanation-



Hence, the appropriate term to come in place of (?) will be UW.

Q.8 In the following questions, select the odd number from the given alternatives.

(A) 362 (B) 145

(C) 26 (D) 625

Ans. (D)

Explanation-

Except the number 625, all other numbers are one more than the perfect square of certain natural numbers. The number 625 is a perfect square number.

$362 = 19 \times 19 + 1$

$145 = 12 \times 12 + 1$

$26 = 5 \times 5 + 1$

But,

$625 = 25 \times 25$

Practice Questions

1. 4, 10, 22, 46, ? Find the missing number.

(A) 56 (B) 66
(C) 76 (D) 94

2. 87, 90, 84, 88, 81, ?, ?

(A) 86,78 (B) 86,88
(C) 86,88 (D) 85,93

3. Which of the following numbers is not correct in the sequence -

3, 6, 10, 16, 21, 28

(A) 10 (B) 3
(C) 16 (D) 21

4. 2, 12, 36, 80, 150, ? Find the missing number.

(A) 210 (B) 258
(C) 252 (D) 194

5. Which of the following numbers is not suitable in the sequence?

19, 28, 39, 52, 67, 84, 102

(A) 84 (B) 102
(C) 67 (D) 52

6. Find the missing letter

(A) WYAC (B) WXYA
(C) WXYZ (D) WYZA

7. 4E, 8I, 13N, 19T, ? Find the missing term.

(A) 26U (B) 26A
(C) 26Z (D) 25X

8. ab__dbc___ ___cda___d_bcab__d

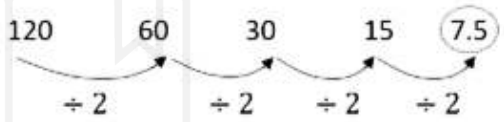
(A) cdabac (B) cdaabc
(C) adabac (D) dadabc

9. 15, 30, 60, 120, ? Find the missing number.

(A) 250 (B) 245
(C) 240 (D) 260

10. 120, 60, 30, 15, ? Find the missing number.

(A) 7.5 (B) 5.7
(C) 3.0 (D) 8.5



11. 4, 10, ? 82, 244, 730

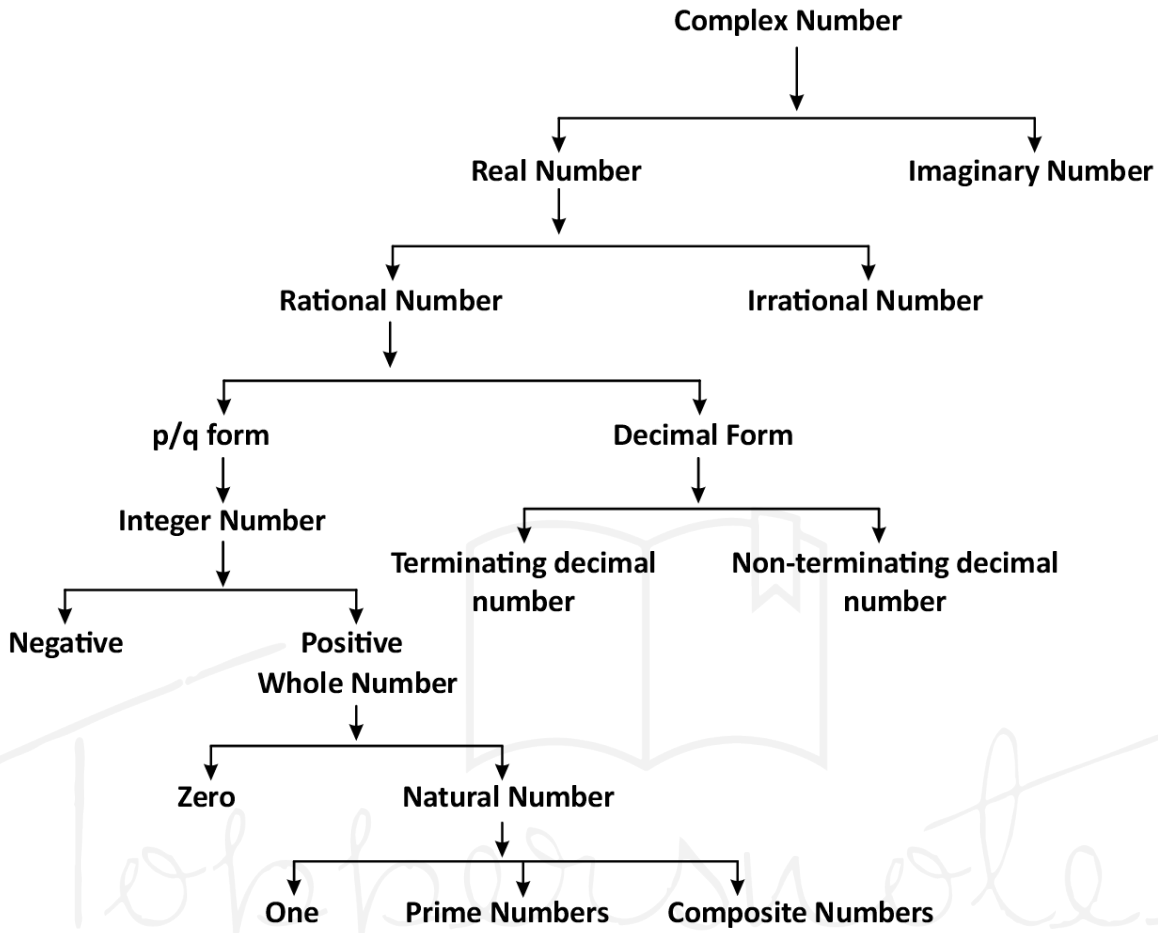
(A) 218 (B) 28
(C) 24 (D) 77

Answer Key

Directions - Find out the related words from the alternatives given below.

Q.1	**(D)**	**Q.2**	**(A)**	**Q.3**	**(C)**	**Q.4**	**(C)**
Q.5	**(B)**	**Q.6**	**(A)**	**Q.7**	**(B)**	**Q.8**	**(A)**
Q.9	**(C)**	**Q.10**	**(A)**	**Q.11**	**(B)**		

14 CHAPTER Number System



Complex Number (Z)

Z = Real numbers + Imaginary numbers

$$Z = a + ib$$

Where, a = Real numbers.
b = Imaginary numbers.

Real Numbers

Rational and irrational numbers together are called real numbers. These can be represented on the number line.

Imaginary Numbers

Numbers that can not be represented on the number line.

Integer Numbers

A set of numbers which includes whole numbers as well as negative numbers, is called integer numbers, it is denoted by I.

I = {–4, –3, –2, –1, 0, 1, 2, 3, 4,.....}

Natural Numbers

The numbers which are used to count things are called natural numbers.

N = {1, 2, 3, 4, 5, ……}

Whole Numbers

When 0 is also included in the family of natural numbers, then they are called whole numbers.

W = {0, 1, 2, 3, 4, 5, …..}

The product of four consecutive natural numbers is always exactly divisible by 24.

Even Numbers

Numbers which are completely divisible by 2 are called even numbers.

n^{th} term = 2n

Sum of first n even natural numbers = n(n+1)

Sum of square of first n even natural numbers = $\frac{2n(n+1)(2n+1)}{3}$

$$\left\{n = \frac{\text{Last term}}{2}\right\}$$

Odd Numbers

The numbers which are not divisible by 2 are odd numbers.

Sum of first n odd numbers = n^2

$$\left\{n = \frac{\text{Last term} + 1}{2}\right\}$$

Natural Numbers

Sum of first n natural numbers = $\frac{n(n+1)}{2}$

Sum of square of first n natural numbers = $\frac{n(n+1)(2n+1)}{6}$

Sum of cube of first n natural numbers = $\left[\frac{n(n+1)}{2}\right]^2$

The difference of the squares of two consecutive natural numbers is equal to their sum.

Example - $11^2 = 121$

$12^2 = 144$

$11 + 12 \rightarrow 23$

Difference 144 – 121 = 23

Prime Numbers – Which have only two forms - 1 × numbers

E.g. - {2, 3, 5, 7, 11, 13, 17, 19……..}

Where, 1 isn't a Prime Number.

- The digit 2 is only even prime number.
- 3, 5, 7 is the only pair of consecutive odd prime numbers.
- Total prime numbers between 1 to 25 = 9
- Total prime numbers between 25 to 50 = 6
- There are total of 15 prime numbers between 1-50.
- There are total of 10 prime numbers between 51 – 100.
  So there are total 25 prime numbers from 1-100.
- Total prime numbers from 1 to 200 = 46
- Total prime numbers from 1 to 300 = 62
- Total prime numbers from 1 to 400 = 78
- Total prime numbers from 1 to 500 = 95

Co-prime Numbers

Numbers whose HCF is only 1.

E.g. - (4,9), (15, 22), (39, 40)

HCF = 1

Perfect Number

A number whose sum of its factors is equal to that number (except the number itself in the factors)

E.g. - 6 → 1, 2, 3 → Here 1 + 2 + 3 → 6

28 → 1, 2, 4, 7, 14 → 1 + 2 + 4 + 7 + 14 → 28

Rational Numbers

Numbers that can be written in the form of P/Q, but where Q must not be zero and P and Q must be integers.

E.g. - 2/3, 4/5, $\frac{10}{-11}, \frac{7}{8}$

Irrational Numbers

These cannot be displayed in P/Q form.

E.g. - $\sqrt{2}, \sqrt{3}, \sqrt{11}, \sqrt{19}, \sqrt{26}$...

Perfect square numbers

↓

Unit Digit which can be of square	Which can't be square
0	2 ——
1	3 ——
4	7 ——
5 or 25	8 ——
6	
9	

- The last two digits of the square of any number will be the same as the last two digits of the square of numbers 1-24.

Note: Therefore, everyone must remember the squares of 1-25.

Convert to Binary and Decimal –

1. **Convert Decimal Number to Binary Number**

   To find the binary number equivalent to a decimal number, we continuously divide the given decimal number by 2 until we get 1 as the final quotient.

   E.g.

2	89	2 × 44 = 88 ; 89 – 88 = 1
2	44	2 × 22 = 44; 44 – 44 = 0
2	22	2 × 11 = 22 ; 22 – 22 = 0
2	11	2 × 5 = 10 ; 11 – 10 = 1
2	5	2 × 2 = 4 ; 5 – 4 = 1
2	2	2 × 1 = 2 ; 2 – 2 = 0
	1	Final quotient

   Hence, binary number equivalent to 89 = $(1011001)_2$

2. **Convert Binary to Decimal Nubmer**

   In binary system the value of 1 when it moves one place to its left every time it doubles itself and wherever 0 comes its value is 0.

   E.g.

1	0	1	1	0	0	1
2^6	2^5	2^4	2^3	2^2	2^1	2^0

   Now

   $(1011001)_2 = 1 \times 2^6 + 0 \times 2^5 + 1 \times 2^4 \times 1 \times 2^3 + 0 \times 2^2 + 0 \times 2^1 + 1 \times 2^0$

   $= 64 + 0 + 16 + 8 + 8 + 0 + 1 \quad \{2^0 = 1\}$

   $= 89$

Finding the Number of Divisors or Number of Factors

First we will do the prime factorization of the number and write it as Power and multiply by adding

One to each power, then the number of divisors will be obtained.

Ex: By how many total numbers can 2280 be completely divided?

Sol. $2280 = 2^3 \times 3^1 \times 5^1 \times 19^1$

Number of divisors = (3 + 1) (1 + 1) (1 + 1) (1 + 1)

$= 4 \times 2 \times 2 \times 2 = 32$

Find the unit's digit

1. **When the number is in the form of power –**

   When the unit digit of Base is 0, 1, 5 or 6, the unit digit of the result remains the same for any natural power. When the unit digit of base is 2, 3, 4, 7, 8, or 9, divide the power by 4 and put the same power on the unit digit of the base as the remainder. When the power is rounded off to 4, then the 4^{th} power will be placed on the unit digit of the base.

2. **In the form of simplification –**

   Write the unit digit of each number and simplify it according to the symbol, the result that will come will be its unit digit answer.

Divide by Power of Numbers (Finding the Divisor)

1. If $a^n + b^n$ is given –
   If n is odd, then (a+b) will be its divisor.
2. If $a^n - b^n$ is given –
   Divisor (when n is odd) $\rightarrow$ (a–b)
   Divisor (when n is even) $\rightarrow$ (a – b) or (a + b) or both.

1. If $a^n \div (a-1)$ then the remainder always be 1.
2. $a^n \div (a+1)$ { If n is an even then the remainder always be 1. / If n is an odd then the remainder always be a.
3. If $(a^n + a) \div (a-1)$ then the remainder always be 2 .
4. $(a^n + a) \div (a+1)$ { If n is an even then the remainder always be zero (0). / If n is an odd then the remainder always be (a – 1)

Terminating Decimal

Those numbers which end after a few digits after the decimal like - 0.25, 0.15, 0.375 can be written in a fraction number.

Non-Terminating Decimal

Those numbers which continue after the decimal and can be of two types.

0.3333, 0.7777, 0.183183183…….

Repeating	Numbers that never end after the decimal, but repeat, till infinity. It can be written in fractions.
Non Repeating Decimal	Numbers that never end after the decimal point, but they do not repeat their numbers.

Recurring Decimal Fraction

That decimal fraction is the repetition of one or more digits after the decimal point, then one or more digits are repeated after the dot.

Eg. $\frac{1}{3} = 0.333..., \frac{22}{7} = 3.14285714.....$ To represent such fractions, a line is drawn over the repeating digit.

$$0.3\overline{524} = \frac{3524-35}{9900} = \frac{3489}{9900} = \frac{1163}{3300}$$

$$\frac{22}{7} = 3.14285714.... = 3.14\overline{2857}$$

It is called bar.

- **Convert pure recurring decimal fraction to simple fraction as follows –**

$$0.\overline{P} = \frac{P}{9} \qquad 0.\overline{pq} = \frac{pq}{99} \qquad 0.\overline{pqr} = \frac{pqr}{999}$$

- **Convert a mixed recurring decimal fraction to an ordinary fraction as follows –**

$$0.p\overline{q} = \frac{pq-p}{90} \qquad 0.pq\overline{r} = \frac{pqr-pq}{900}$$

$$0.p\overline{qr} = \frac{pqr-p}{990} \qquad 0.pq\overline{rs} = \frac{pqrs-pq}{9900}$$

Example -

(i) $0.\overline{39} = \frac{39}{99} = \frac{13}{33}$

(ii) $0.6\overline{25} = \frac{625-6}{990} = \frac{619}{990}$

(iii) $0.3\overline{524} = \frac{3524-35}{9900} = \frac{3489}{9900} = \frac{1163}{3300}$

Symbol of the Roman Method

1	→	I
2	→	II
3	→	III
4	→	IV
5	→	V
6	→	VI
7	→	VII
8	→	VIII
9	→	IX
10	→	X
20	→	XX
30	→	XXX
40	→	XL
50	→	L
100	→	C
500	→	D
1000	→	M

Rule of Divisibility

Rule of 2	The last digit is an even number or zero (0) as - 236, 150, 1000004
Rule of 3	If the sum of the digits of a number is divisible by 3, then the whole number will be divisible by 3. E.g. 729, 12342, 5631
Rule of 4	Last two digits are zero or divisible by 4. E.g. 1024, 58764, 567800
Rule of 5	The last digit is zero or 5. E.g. 3125, 625, 1250
Rule of 6	If a number is divisible by both 2 and 3 then it is also divisible by 6. E.g. 3060, 42462, 10242
Rule of 7	After multiplying the last digit of a number by 2 and subtracting it from the remaining number, if the number is a multiple of 0 or 7 or if any digit is repeated in a multiple of 6**,** then the number will be divisible by 7**.** E.g. 222222, 44444444444, 7854
Rule of 8	If the last three digits of a number are divisible by 8 or the last three digits are '000' (zero). E.g. 9872, 347000
Rule of 9	If the sum of the digits of a number is divisible by 9, then the whole number will be divisible by 9.
Rule of 10	The last digit should be zero (0).
Rule of 11	If the difference between the sum of digits at odd places and sum of digits at even places is zero (0) or 11 or a multiple of 11. E.g. 1331, 5643, 8172659
Rule of 12	Composite form of divisible by 3 and 4.
Rule of 13	Repeating the digit 6 times, or multiplying the last digit by 4 and adding it to the remaining number, if the number is divisible by 13, then the whole number will be divisible by 13**.** E.g. 222222, 17784

Practice Questions

Q.1 If $\frac{3}{4}$ of a number is 7 more than $\frac{1}{6}$ of that number, then what will be $\frac{5}{3}$ of that number?

(a) 12 (b) 18

(c) 15 (d) 20

Q.2 If the sum of two numbers is a and their product is a then their reciprocals will be –

(a) $\frac{1}{a}+\frac{1}{b}$ (b) $\frac{b}{a}$

(c) $\frac{a}{b}$ (d) $\frac{a}{ab}$

Q.3 The sum of two numbers is 75 and their difference is 25, then what will be the product of those two numbers?

(a) 1350 (b) 1250

(c) 1000 (d) 125

Q.4 Divide 150 into two parts such that the sum of their reciprocal is $\frac{3}{112}$. Calculate both parts.

(a) 50, 90 (b) 70, 80

(c) 60, 90 (d) 50, 100

Q.5 If the sum of any three consecutive odd natural numbers is 147, then the middle number will be –

(a) 47 (b) 48

(c) 49 (d) 51

Q.6 If the product of first three and last three of 4 consecutive prime numbers is 385 and 1001, then find the greatest prime number.

Q.7 What will be the sum of the even numbers between 50 and 100?

Q.8 What will be the sum of odd numbers between 50 and 100?

Q.9 In a division method, the divisor is 12 times the quotient and 5 times the remainder. Accordingly, if the remainder is 36, then what will be the dividend?

(a) 2706 (b) 2796

(c) 2736 (d) 2826

Q.10 What is the unit digits of $(3694)^{1739} \times (615)^{317} \times (841)^{491}$

(a) 0 (b) 2

(c) 3 (d) 5

Q.11 What will be written in the form of $\frac{p}{q}$ of 18.484848....?

(a) $\frac{462}{25}$ (b) $\frac{610}{33}$

(c) $\frac{200}{11}$ (d) $\frac{609}{33}$

Q.12 Put $\frac{0.\overline{936}-0.\overline{568}}{0.\overline{45}+2.\overline{67}}$ in the form of rational number.

Q.13 What will be the common factor of $\left\{(127)^{127}+(97)^{127}\right\}$ and $\left\{(127)^{97}+(97)^{97}\right\}$?

(a) 127 (b) 97

(c) 30 (d) 224

Answer Key

Q.1 (d) **Q.2 (c)** **Q.3 (b)** **Q.4 (b)**

Q.5 (c) **Q.6 13** **Q.7 1800** **Q.8 1875**

Q.9 (c) **Q.10 (a)** **Q.11 (b)** **Q.12 $\frac{2024}{17205}$**

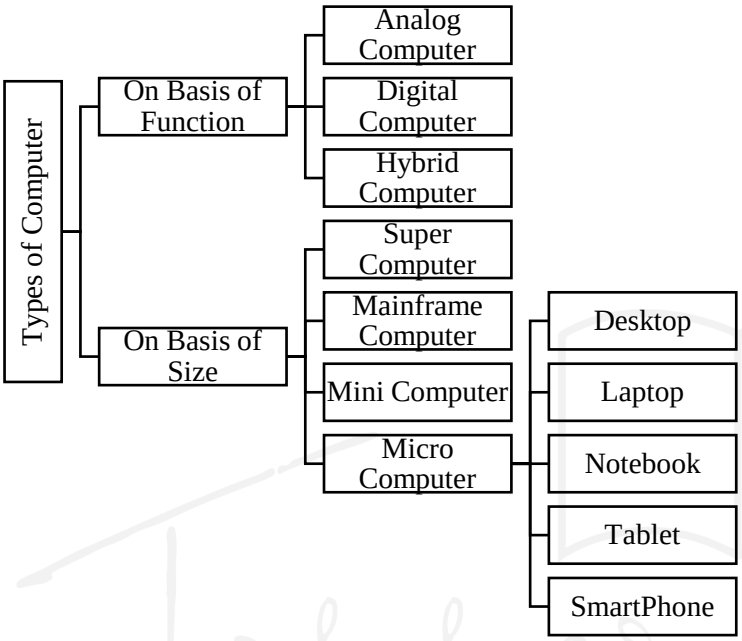
Q.13 (d)

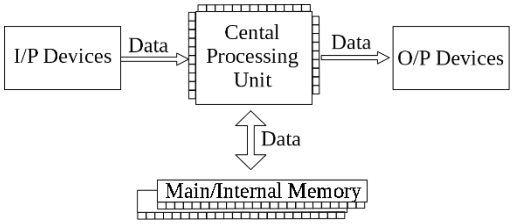
30 CHAPTER

Basic of Computer

"A computer would deserve to be called intelligent if it could deceive a human into believing that it was human." **–Alan Turing (father of modern computers)**.

A computer is an electronic device that can be programmed to **accept data (input), process** it and **generate results (output**). A computer along with additional hardware and software together is called a computer system.





Types of Computer: On Basis of Function:

1. **Analog Computer:** Analog computers process **continuous data** and work with **physical quantities** like voltage, temperature, speed, and pressure.
   Ex: Thermometer, Speedometer, Seismograph
2. **Digital Computer**: Digital computers process **discrete (binary) data** using **0s and 1s**, performing calculations and logical operations.
   Ex: Personal Computer (PC), Laptops, Supercomputers
3. **Hybrid Computer**: Hybrid computers combine **both analog and digital features**, processing continuous (analog) and discrete (digital) data.
   Ex: ECG Machine (Electrocardiogram), Flight Simulators, Weather Prediction System

Types of Computers: On Basis of Size:

Mainframe Computer :

- Mainframes are a type of computer, which are made for **'throughput'** as fast as possible. Throughput can be defined as **"the rate at which the data is processed".**
- They are very large in size.
- They have greater processing power and memory as compared to minicomputers.
- Multiple users work at a time on these computers. They are expensive.
- They are generally used in railway reservations, insurance companies, research institutes and professional organizations.
- IBM 4300, IBM4381, UAX 8842 etc are examples of mainframe computers.

- **Historical Overview :**
  - ✓ First Mainframe Computer: Harvard Mark I (1944).
  - ✓ IBM 700 series (1950s-60s) revolutionized mainframes.
  - ✓ **Gene Amdahl** is widely considered the **"father of the mainframe computer"** and played a key role in the design of IBM's mainframe computers, including the IBM 704.

Mini computer :

- A Minicomputer is a mid-sized computing device that is more powerful than a microcomputer but less powerful than a mainframe. It is designed for multi-user operations
- They have more processing power and storage capability. They have more than one CPU. More than one person can work upon them at a given time.
- They are generally used in big offices, banks etc.
- **Historical Overview :**
  - ✓ **First Minicomputer**: **PDP-8** (1965) by **Digital Equipment Corporation (DEC)**.
  - ✓ **1970s & 1980s**: Minicomputers became popular in **businesses, research institutions, and industry**.
  - ✓ **Modern Minicomputers**: Still used in **networking, industrial automation, and cloud computing**.

Micro computer :

- A Microcomputer is the smallest and most commonly used type of computer designed for individual use.
- They are small in size and less costly.
- They are used at homes, in schools. A micro computer consists of a single CPU.
- They have comparatively less memory and working speed.
- A single person can work on it at a given time. They are also called personal computers.
- **Historical Overview :**
  - ✓ **First Microcomputer**: **Micral (1973)** – First commercially available microcomputer.
  - ✓ **Popularized by**: **Apple I (1976), IBM PC (1981)**.
  - ✓ **Modern microcomputers**: Now include **desktops, laptops, notebooks, tablets, and smartphones**.

Types of Microcomputers		
Type	**Description**	**Example**
Desktop Computer	A stationary computer designed for office and home use, requiring an external monitor, keyboard, and mouse.	**Dell OptiPlex, HP Pavilion, Apple iMac**
Laptop	A portable computer with a built-in keyboard, display, and battery, used for personal and professional tasks.	**MacBook Air, Lenovo ThinkPad, Dell XPS**
Notebook	A thinner, lightweight version of a laptop with similar functionality but improved portability.	**ASUS ZenBook, HP Spectre, Dell XPS 13**
Tablet	A touchscreen-based, portable computing device that runs mobile operating systems.	**Apple iPad, Samsung Galaxy Tab, Microsoft Surface**
Smartphone	A mobile computing device with a touchscreen, calling features, and internet connectivity.	**iPhone, Samsung Galaxy, Google Pixel**
Personal Digital Assistant (PDA)	A small handheld device used for organizing personal information, now mostly replaced by smartphones.	**Palm Pilot, BlackBerry PDA**
Gaming Console	A microcomputer designed specifically for gaming and multimedia applications.	**Sony PlayStation, Microsoft Xbox, Nintendo Switch**
Embedded Computer	A specialized microcomputer embedded in electronic devices for a specific function.	**Smart TVs, ATMs, Car GPS Systems**

Supercomputer:

- Supercomputers are the largest in size. They are the most powerful in processing and memory.
- They process complex calculations with high accuracy.
- A Supercomputer is the most powerful and fastest type of computer, capable of performing trillions of calculations per second.
- It is used for complex computations in scientific research, artificial intelligence, and large-scale simulations.
- FLOPS [Floating Point Operation Per Second] is the unit of measurement for speed.
- **Historical Overview:**
  - ✓ **First Supercomputer**: **CDC 6600 (1964)**, developed by **Seymour Cray (Father of Super Computer)**.
  - ✓ **Cray-1 (1976)**: Introduced vector processing technology.
  - ✓ **Modern Supercomputers**: Use **parallel processing**, AI, and **quantum computing** to enhance speed.

Supercomputer in India:

India has developed several high-performance supercomputers for scientific research, weather forecasting, artificial intelligence, and space exploration. These systems are developed by organizations like C-DAC (Centre for Development of Advanced Computing), ISRO, and IITs.

Historical Overview:

- India launched its own supercomputing program in 1988, under the leadership of Dr. Vijay Bhatkar (Father of supercomputers in India).
- The Centre for Development of Advanced Computing (C-DAC) was established in 1988 to develop indigenous supercomputers.
- **PARAM 8000 – India's First Supercomputer (1991)** :
  - ✓ Developed by: C-DAC.
  - ✓ Processing Power: 1 GFLOP (Giga Floating Point Operations Per Second).
  - ✓ Significance: Marked India's entry into the global supercomputing race.
  - ✓ Impact: Led to technological self-reliance in high-performance computing.
- **National Supercomputing Mission (NSM) :**
  - ✓ Launched in 2015 to develop world-class supercomputing infrastructure in India.
  - ✓ **Objective:** Build indigenous supercomputers and deploy them in academic institutions for research.
  - ✓ **Implemented by:**
    - C-DAC (Centre for Development of Advanced Computing).
    - DST (Department of Science & Technology).
    - MeitY (Ministry of Electronics & Information Technology).
  - ✓ **Target:** Install **70+ supercomputers across India**.

List of Major Supercomputers in India

Supercomputer Name	Institution	Processing Power	Application
PARAM Siddhi-AI (Top 100-150)	C-DAC (Pune)	**5.267 PFLOPS**	AI, Drug Discovery, Deep Learning
Pratyush	IITM Pune	**4.0 PFLOPS**	Weather & Climate Research
Mihir	NCMRWF, Noida	**2.8 PFLOPS**	Meteorological Simulations
EKA	CRL, Pune (Tata Group)	**172 TFLOPS**	AI & Scientific Computing
SAGA-220	ISRO	**220 TFLOPS**	Space Research & Aerospace Simulations
PARAM Yuva-II	C-DAC	**500 TFLOPS**	General Research & Data Analysis
PARAM Brahma	IISER Pune	**850 TFLOPS**	Scientific Research
PARAM Yukti	JNCASR (Bangalore)	**450 TFLOPS**	Molecular & Material Science
PARAM Shivay	IIT-BHU (Banaras Hindu University)	**833 TFLOPS**	Academic Research & Data Science

PARAM Sanganak	IIT Kanpur	**1.6 PFLOPS**	AI & Deep Learning
PARAM Pravega	IISc Bangalore	**3.3 PFLOPS**	Scientific Research & Cloud Computing
Flosolver MK6	NAL (National Aerospace Laboratories)	**50 TFLOPS**	Aerospace & Fluid Dynamics

Development of Computer

Year	Descriptions
1617 AD	**Napier's Bones** ➢ A manually operated calculating device. ➢ Invented by Scottish mathematician John Napier. ➢ Used for multiplication and division. ➢ A tool to simplify complex calculations, considered one of the most significant advancements in the study and practical applications of mathematics.
1642 AD	**Pascaline** ➢ Also known as the Adding Machine. ➢ Invented by Blaise Pascal. ➢ Used for addition and subtraction only. ➢ Operated based on the principles of a clock and odometer.
1694 AD	**Leibniz Wheel** ➢ Considered an improved version of Pascaline. ➢ Developed by Gottfried Wilhelm von Leibniz. ➢ Capable of performing basic mathematical operations (addition, subtraction, multiplication, and division).
1801–1805	**Punch Cards** ➢ Developed by Joseph Jacquard for use in mechanical looms. ➢ First mechanical loom that used punched cards to store weaving designs. ➢ Played a crucial role in the development of computers based on two key ideas: ✓ Information was coded using punch cards. ✓ Stored data and instructions on punch cards functioned as a program.
1822 AD	**Difference Engine** ➢ A gear, shaft, and steam-powered machine. ➢ Invented by Charles Babbage. ➢ The first error-free device for mathematical and statistical calculations. ➢ Used for creating mathematical tables and could perform 60 additions per minute. ➢ Had memory capability and operated based on programmed instructions.
1833 AD	**Analytical Engine** ➢ In 1833 AD, Charles Babbage developed an advanced version of the Difference Engine, known as the Analytical Engine. ➢ It was capable of operating based on instructions stored on punch cards. ➢ The punch cards were used not only to store instructions but also to record input and output data. ➢ A key feature of this machine was its ability to perform calculations up to the 50th decimal place. ➢ It could also compute the square root of whole numbers, and the results were automatically printed. ➢ Memory was used for data storage in this machine. ➢ It had separate devices for input and output operations.

1889–1890 AD	**Hollerith Census Tabulator** ➢ A punch card-based census machine. ➢ Developed by American mathematician Herman Hollerith. ➢ Introduced the concept of punch cards as a computing tool, pioneered by Herman Hollerith.
1939–1942	**ABC Computer (Atanasoff-Berry Computer)** ➢ Developed by: John Atanasoff and Clifford Berry. ➢ First fully automatic electronic digital computer. ➢ Work on this computer continued from 1939 to 1942, and in 1942, it was released in England by John Atanasoff and Clifford Berry.
1944 AD	**MARK-I** ➢ Inventors & Developers: Howard Aiken & IBM (International Business Machines). ➢ World's first fully automatic electro mechanical calculating machine. ➢ Used for performing complex mathematical calculations. ➢ Full name: Automatic Sequence Controlled Calculator (ASCC). ➢ Capabilities: ✓ Could perform **multiplication in 6 seconds**. ✓ Could perform **division in 12 seconds**.
1946 AD	**ENIAC (Electronic Numerical Integrator and Computer)** ➢ Developed by: A team of scientists at the University of Pennsylvania led by J. Presper Eckert and John William Mauchly. ➢ World's first fully electronic computer.
1947 AD	**EDVAC (Electronic Discrete Variable Automatic Computer)** ➢ Developed by: John von Neumann. ➢ Capable of storing data and instructions in binary form (0s and 1s). ➢ First stored-program digital computer.
Some Important Facts ➢ **Lady Ada Augusta** ✓ The **first woman to program the Analytical Engine**. ✓ She is known as the **world's first programmer**. ✓ She is also credited with the **invention of the binary system**. ➢ **John von Neumann**: ✓ Introduced the concept of **logical design with stored programs**. ✓ Credited with **storing data and instructions in binary form**. ✓ He is known as the **Father of Modern Computers**. The concept of **stored program** states that **a program and memory can be stored in the same memory.**	
1949 AD	**EDSAC (Electronic Delay Storage Automatic Calculator)** ➢ Developed by **Professor Maurice Wilkes** at **Cambridge University**. ➢ It was the **first stored-program digital computer**.
1951 AD	**UNIVAC (Universal Automatic Computer)** ➢ Developed by **General Electric Corporation**. ➢ Designed by **John Mauchly and J. Presper Eckert**. ➢ **First commercial computer** used for **business and general-purpose applications**.