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STUDY MATERIAL-2015

//check alphabet is vowel or not

```cpp
#include <iostream.h>
#include<conio.h>
void main()
{ clrscr();
  cout<<"Program To Check Vowel :\n";
  char ch;
  cout<<"\nInput a character: ";
  cin>>ch;
  switch(ch)
  { case 'a':  case 'A':
    case 'e':  case 'E':
    case 'i':  case 'I':
    case 'o':  case 'O':
    case 'u':  case 'U':
      cout<<"\n"<<ch<<" is a Vowel";
      break;
    default:cout<<"\n"<<ch<<" is not a Vowel";
  }
getch();

}
```

//count no.of vowels

```cpp
#include<iostream.h>
#include<stdio.h>
#include<conio.h>
void main()
{
 char ch[20];
 int i,count=0;
 clrscr();
 cout<<"Prgram to count number of vowels:\n";
 cout<<"Enter the string\n";
 gets(ch);
 for(i=0;ch[i]!='\0';i++)
 {
 if(ch[i]=='a' || ch[i]=='e' || ch[i]=='i' || ch[i]=='o' ||
  ch[i]=='u'|| ch[i]=='A' || ch[i]=='E' || ch[i]=='I' || ch[i]=='O' ||
  ch[i]=='U')
 {
  count++;
 }
```

```
 }
 cout<<"Vowels = "<<count;
 getch();
}
```

```
#include<iostream.h>
#include<conio.h>
void main()
 { clrscr();
   int i,a,b,even,odd; even=odd=0;
   cout<<"Sum of even and odd no. \n";
   cout<<"Enter starting no. = ";
   cin>>a;
   cout<<"\nEnter last no.    = ";
   cin>>b;
   for (i=a;i<=b;i++)
  { if(i%2==0)
    even =even+i ;
    else{odd =odd+i;}
  }
  cout<<"\nsum of even no. is = "<<even<<"\n"<<"sum of odd  no. is = "<<odd;
 getch();
 }
```

```
#include<iostream.h>
#include<conio.h>
void main()
 { clrscr();
   int n;
   cout<<"Print Table Of any no. (by:\n\n";
   cout<<"Enter number to print it's table = ";
   cin>>n;
   for(int i=1;i<=20;i++)
    {cout<<"\n"<<n<<"*"<<i<<" =  "<<n*i;
    }
 getch();
 }
```

```
#include<iostream.h>
#include<conio.h>
void main()
{ clrscr();
   int num, i,count=0;
   cout<<"Program to check no. is Prime:\n";
   cout<<"Enter number to check Prime or not :- ";
   cin>>num;
   for(i=2;i<=num-1;i++)
    { if(num%i==0)
    count=count+1;
    }
    if(count==0)
      cout<<"\n"<<num<<" is a Prime number";
```

```cpp
    else cout<<"\n"<<num<<" is not a prime number";
getch();
}
```

```cpp
//reverse of a no.
#include<iostream.h>
#include<conio.h>
void main()
{ clrscr();
  int n,a,b,c,d;
  cout<<"Reverse Traversal :\n";
  cout<<"Enter four digit number \n";
  cin>>n;
  if(n!=0)
   { a=n%10;
     b=n/10%10;
     c=n/100%10;
     d=n/1000%10;
     cout<<a<<b<<c<<d;
   }
getch();
}
```

```cpp
//prime series upto n

#include<iostream.h>
#include<conio.h>
void main()
{clrscr();
 int n;
 cout<<"PRIME NO. SERIES :\n";
 cout<<"\nINPUT THE VALUE OF N: " ;
 cin>>n;
 cout<<"\nTHE PRIME NO. SERIES B/W 1 TO"<<n<<"\n";
 for(int i=1;i<=n;i++)
   {
    for(int j=2;j<=i-1;j++)
   {
  if(i%j==0)
      break;
   }
  if (i==j)
    cout<<i<<" ";

   }
getch();
}
```

```cpp
//power of no.
#include<iostream.h>
#include<conio.h>
#include<math.h>
void main()
{clrscr();
double no,r,res;
cout<<"Enter Number : ";
```

```cpp
cin>>no;
cout<<"Enter raised/power : ";
cin>>r;
res=pow(no,r);
cout<<"\nResult is "<< res;
getch ();
}
```

//pallindrome no
```cpp
#include<iostream.h>
#include<conio.h>
void main()
{  clrscr();
   int n, reverse = 0, temp;
   cout<<"Program to check Palindrome Condition:\n";
   cout<<"\nEnter a number :";
   cin>>n;
   temp=n;
   while( temp != 0 )
     {reverse = reverse * 10;
      reverse = reverse + temp%10;
      temp = temp/10;
     }
   if(n==reverse)
     cout<<"\n"<<n<<" is a palindrome number.\n";
   else
     cout<<"\n"<<n<<" is not a palindrome number.\n";
getch();

}
```

//swapno

```cpp
#include<iostream.h>
#include<conio.h>
void main()
{clrscr();
 int a,b,temp=0;
 cout<<"Program to swap two number :\n\n";
 cout<<"Enter first number (let a)  : ";
 cin>>a;
 cout<<"\nEnter second number (let b) : ";
 cin>>b;
 temp=a;
 a=b;
 b=temp;
 cout<<"\nAfter swap :- ";
 cout<<"\n\t\tValue of a is : "<<a<<"\n\n\t\tValue of b is : "<<b;
getch();
}
```

//HCF calculation

```cpp
#include<iostream.h>
#include<conio.h>
void main()
```

```cpp
{   clrscr();
    int num1,num2;
    cout<<" Find HCF of two number:\n";
    cout<<"Enter first number : ";
    cin>>num1;
    cout<<"Enter second number : ";
    cin>>num2;
    cout<<"HCF of "<<num1<<" & "<<num2<<" is : ";
    while(num1!=num2)
    {if(num1>num2)
        num1-=num2;
    else num2-=num1;
    }
    cout<<num1;
    getch();
}
```

//count no.of digits
```cpp
#include<iostream.h>
#include<conio.h>
void main()
{   clrscr();
    long int num,digit,sum=0,count=0;
    cout<<"sum of digit and count number of digits in a number:\n";
    cout<<"Enter number : ";
    cin>>num;
    while(num!=0)
    {
    digit=num%10;
    sum=sum+digit;
    num=num/10;
     count++;
    }
    cout<<"sum of digits:"<<sum;
    cout<<"Number of Digit is : "<<count;
getch();
}
```

//average of no in array
```cpp
#include <iostream.h>
#include <conio.h>
int main()
{   clrscr();
    int n, i;
    float num[100], sum=0.0, average;
    cout<<"Program to calculate Average using array:\n";
    cout<<"Enter the numbers of data : ";
    cin>>n;
    while (n>100 || n<=0)
    {   cout<<"Error! number should in range of (1 to 100).\n";
    cout<<"Enter the number again : ";
    cin>>n;
    }
    for(i=0; i<n; ++i)
    {
      cout<<i+1<<" Enter number : ";
```

```cpp
    cin>>num[i];
    sum+=num[i];
  }
  average=sum/n;
  cout<<"Average = "<<average;

getch();
return 0;
}
```

//Armstrong no
```cpp
#include<iostream.h>
#include<conio.h>
void main()
{ clrscr();
  int temp,num,sum=0,r;
  cout<<"Program to check Armstrong condition :\n";
  cout<<"Enter a number : ";
  cin>>num;
  temp=num;
  while(num!=0)
     {r=num%10;
     num=num/10;
     sum=sum+(r*r*r);
     }
  if(sum==temp)
    cout<<endl<<temp<<" is a Armstrong number. \n";
  else cout<<endl<<temp<<" is not a Armstrong number./n";
getch();
}
```

//calculate npr,ncr
```cpp
#include<iostream.h>
#include<conio.h>
long fnpr(int, int);
long fncr(int, int);
long factorial(int);
void main()
{
 int n, r;
 long ncr, npr;
 clrscr();
 cout<<"Calculate nCr & nPr:\n";
 cout<<"\nEnter the value of n : ";
 cin>>n;
 cout<<"Enter the value of r : ";
 cin>>r;
 ncr=fncr(n,r);
 npr=fnpr(n,r);
 cout<<"\nValue of "<<n<<"C"<<r<<" = "<<ncr;
 cout<<"\nValue of "<<n<<"P"<<r<<" = "<<npr;
 getch();
}
long fnpr(int n,int r)
{
```

```cpp
 long value;
 value=factorial(n)/factorial(n-r);
 return value;
}
long fncr(int n,int r)
{
 long value;
 value=factorial(n)/(factorial(r)*factorial(n-r));
 return value;
}
long factorial(int n)
{
 if(n==0)
   return 1;
 else
 {
 return(n*factorial(n-1));
 }
}
```

```cpp
#include <iostream.h>
#include <conio.h>
#include <math.h>
int binary_decimal(int n);
int decimal_binary(int n);
int main()
{ clrscr();
  int n;
  char c;
  cout<<"Convet Decimal to Binary & vice versa :\n";
  cout<<"1. Enter alphabet 'd' to convert binary to decimal.\n";
  cout<<"2. Enter alphabet 'b' to convert decimal to binary.\n";
  cin>>c;
  if (c =='d' || c == 'D')
  {  cout<<"\nEnter a binary number : ";
    cin>>n;
    cout<<n<<" in binary = "<<binary_decimal(n)<<" in decimal";
  }
  if (c =='b' || c == 'B')
  {  cout<<"\nEnter a decimal number : ";
    cin>>n;
    cout<<n<<" in decimal = "<<decimal_binary(n)<<" in binary";
  }
getch();
return 0;
}

int decimal_binary(int n)
{  int rem, i=1, binary=0;
    while (n!=0)
    {  rem=n%2;
    n/=2;
    binary+=rem*i;
    i*=10;
    }
```

```cpp
        return binary;
}

int binary_decimal(int n)
{  int decimal=0, i=0, rem;
    while (n!=0)
    {   rem = n%10;
    n/=10;
    decimal += rem*pow(2,i);
    ++i;
    }
    return decimal;
}
```

// mathematical operation like sqrt,cos sin...

```cpp
#include<iostream.h>
#include<conio.h>
#include<math.h>
void main()
{clrscr();
 int choice;double arg,arg1,arg2,arg3,num,num1,num2;
 cout<<"Mathematical Operation:\n";
 again:
 cout<<"\n1=exp   (eg:e^2)\n2=log   (eg:log(1))";
 cout<<"\n3=log10 (eg:log10(1))\n4=sqrt  (eg:sqrt(81))\n5=sin\n6=cos\n7=tan\n";
 cout<<"\nEnter CHOICE: ";
 cin>>choice;
 switch(choice)
 {case 1: cout<<"\nEnter power of e :";
  cin>>arg;
  cout<<"\nValue is: "<<exp(arg);break;
 case 2: cout<<"\nEnter value of log :";
  cin>>num;
  cout<<"\nValue is: "<<log(num);break;
 case 3: cout<<"\nEnter value of log10 :";
  cin>>num1;
  cout<<"\nValue is: "<<log10(num1);break;
 case 4: cout<<"\nEnter value for sqrt :";
  cin>>num2;
  cout<<"\nValue is: "<<sqrt(num2);break;
 case 5: cout<<"\nEnter value of sin in radian :";
  cin>>arg1;
  cout<<"\nValue is: "<<sin(arg1);break;
 case 6: cout<<"\nEnter value of cos in radian :";
  cin>>arg2;
  cout<<"\nValue is: "<<cos(arg2);break;
 case 7: cout<<"\nEnter value of tan in radian :";
  cin>>arg3;
  cout<<"\nValue is: "<<tan(arg3);break;
 default:cout<<"\nWrong Choice\n";goto again;
}
getch();
}
```

```cpp
// calculate root of quartic equation

#include<conio.h>
#include<iostream.h>
#include<math.h>
void main()
{clrscr();
 cout<<"Program to Print Roots of Quadrtic Equation : \n";
 float a,b,c,root1,root2,delta;
 cout<<"Enter three constant a,b & c of ax^2 + bx + c \n";
 cin>>a>>b>>c;
 if(a==0)
   cout<<"value of a not be zero ";
 else{
 delta=b*b-4*a*c;

    if  (delta>0)
  { root1= (-b+sqrt(delta))/(2*a);
    root2= (-b-sqrt(delta))/(2*a);
    cout<<"Roots are Real and Unequal\n";
    cout<<"Root1= "<<root1<<"\nRoot2= "<<root2;
  }
    else{ if(delta==0)
        { root1=-b/(2*a);
  cout<<"Roots are Real & Equal\n";
  cout<<"Root1= "<<root1<<"\nRoot2= "<<root2;
        }
    else cout<<"Roots are Complex and Imaginary \n";
  }
  }
getch();
}


//mathematical operation

#include<iostream.h>
#include<conio.h>
void main()
{ clrscr();
 float a,b,add,sub,mul,div,choice;
 cout<<"Mathematical Operation :  \n";
 cout<<"\nEnter Two Values for operation \n "; cin>>a>>b;
 cout<<"Enter your choice (type 1,2,3,4) \n";
 cout<< " 1 - Addition \n 2 - Subtract \n 3 - Division \n 4 - Multiply \n";
 cin>>choice;
 if(choice==1)
   { add =a+b;  cout<<"\n Addition is "<<add;}
 if(choice==2)
   { sub=a-b;   cout<<"\n Subtraction is "<<sub;}
 if(choice==3)
   { div=a/b;   cout<<"\n Division is "<<div;}
 if(choice==4)
   { mul=a*b;   cout<<"\n Multiplication is "<<mul;}
getch();
}
```

```
//calculate sum of AP
#include<iostream.h>
#include<conio.h>
#include<math.h>
void main()
{
 int a,d,n,i,nth;
 int sum=0;
 clrscr();
 cout<<"Program to Calculate sum of A.P series :\n";
 cout<<"\nEnter the first number of the series : ";
 cin>>a;
 cout<<"\nEnter the number of terms in series : ";
 cin>>n;
 cout<<"\nEnter the common difference of series : ";
 cin>>d;
 sum=(n*(2*a+(n-1)*d))/2;
 nth=a+(n-1)*d;
 cout<<"\nSum of the A.P. is : ";
 for(i=a;i<=nth;i=i+d)
 {
  if(i!=nth)
  {
    cout<<i<<" + ";
  }
  else
  {
    cout<<i<<" = "<<sum;
  }
 }
 getch();
}

// calculate sum of 1+2+3+4....
#include<iostream.h>
#include<conio.h>
void main()
{
 int n,i;
 int sum=0;
 clrscr();
 cout<<"Program to calculatesum 1+2+3+...n :\n";
 cout<<"\nEnter the value of n : ";
 cin>>n;
 sum=(n*(n+1))/2;
 cout<<"\nSum of the series: ";
 for(i=1;i<=n;i++)
 {
  if (i!=n)
  {
    cout<<i<<" + ";
  }
  else
  {
    cout<<i<<" =  "<<sum;
```

```cpp
 }
 }
 getch();
}
```

//Transpose matrix

```cpp
#include<iostream.h>
#include<conio.h>

void main()
{clrscr();
 int a[10][10],b[10][10],i,j,m,n;
 cout<<"Program for Transpose of Matrix :\n";
 cout<<"Enter number of row in matrix    : ";
 cin>>m;
 cout<<"Enter number of column in matrix : ";
 cin>>n;
 cout<<"\nEnter elements in an matrix : ";

 for(i=0;i<m;i++)
   {for(j=0;j<n;j++)
   {cin>>a[i][j];
   }
   }
 cout<<"\nInput matrix : \n";
 for(i=0;i<m;i++)
   {for(j=0;j<n;j++)
   {cout<<a[i][j]<<" ";
   }
    cout<<"\n";
   }

 for(i=0;i<m;i++)
   {for(j=0;j<n;j++)
   {b[i][j]=a[j][i];
   }
   }
 cout<<"\nTranspose matrix : \n";
 for(i=0;i<m;i++)
   {for(j=0;j<n;j++)
   {cout<<b[i][j]<<" ";
   }
    cout<<"\n";
   }
getch();
}
```

//check no is even or odd

```cpp
#include<iostream.h>
#include<conio.h>
void main()
{clrscr();
 int a;
 cout<<"Check Number is Even or Odd :\n";
 cout<<"\nEnter number to  check : ";
 cin>>a;
```

```cpp
 if(a%2==0)
 cout<<"\n"<<a<<" is a Even number ";
 else cout<<"\n"<<a<<" is a Odd number ";
getch();
}
```

//check a year is leap or not

```cpp
#include<iostream.h>
#include<conio.h>
void main()
{ clrscr();
 int year;
 cout<<"Program to check Leap year:\n";
 cout<<"Enter a year to check : ";
 cin>>year;
 if ( year%400 == 0)
  cout<<year<<" is a leap year\n";
 else if ( year%100 == 0)
  cout<<year<<" is not a leap year\n";
 else if ( year%4 == 0 )
  cout<<year<<" is a leap year\n";
 else
  cout<<year<<" is not a leap year\n";
getch();

}
```

//matrix in c++

```cpp
#include<iostream.h>
#include<conio.h>
void main()
{ clrscr();
 int a[10][10],b[10][10],c[10][10],l,m,n,o,i,j,k;
 cout<<"Matrix Multiplication :\n";
 again:
 cout<<"\nEnter Row & Column Of Matrix A \n";
 cin>>l>>m;
 cout<<"\nEnter Row & Column Of Matrix B \n";
 cin>>n>>o;
 if(m==n)
 {cout<<"Matrix Can Be Multiply \n";
 }
 else{ cout<<"Incorrect Matrix For Multiplication \n";
   goto again;
   }
 cout<<"\nEnter Elements Of Matrix A: \n";
 for(i=0;i<l;i++)
  { for(j=0;j<m;j++)
 {cin>>a[i][j];
 }
  }
 cout<<"\nEnter Elements Of Matrix B: \n";
  for(i=0;i<n;i++)
   { for(j=0;j<o;j++)
   {cin>>b[i][j];
   }
   }
  for(i=0;i<l;i++)
```

```
      {for(j=0;j<o;j++)
   {c[i][j]=0;
      for(k=0;k<m;k++)
   {c[i][j]=c[i][j]+(a[i][k]*b[k][j]);
   }
   }
      }
   cout<<"\nMultiplication Of Matrix A & B: ";
   for(i=0;i<l;i++)
      {cout<<"\n";
  for(j=0;j<o;j++)
     { cout<<c[i][j]<<"  ";
     }
      }
getch();

}
```

//swap using pointer

```
#include<iostream.h>
#include<conio.h>
void swap(int *x,int *y);
void main()
{clrscr();
 int a,b;
 cout<<"\tThe program for Swapping using pointers :\n";
 cout<<"Enter First Value : ";
 cin>>a;
 cout<<"Enter Second Value: ";
 cin>>b;
 swap(&a,&b);
 cout<<"\nSwapped Values\n";
 cout<<"a="<<a<<"and b="<<b<<"\n";
 getch();
}
void swap(int *x,int *y)
{int temp;
 temp=*x;
 *x=*y;
*y=temp;
}
```

//square matrix addition and substraction
```
#include<iostream.h>
#include<conio.h>
void main()
 { clrscr();
   int i,j,r,c,choice;
   int matrix1[5][5];
   int matrix2[5][5];
   int sum[5][5],sub[5][5];
   cout<<"Square Matrix Addition & Subtraction by-Tarun Rawat\n";
   cout<<"Enter Row & Column  = ";cin>>r>>c;
   cout<<"Enter matrix 1st \n";
   for (i=0;i<r;i++)
      {for (j=0;j<c;j++)
```

```cpp
            {cin>>matrix1[i][j];
            }
          }
      cout<<"Entered Matrix is\n";
      for (i=0;i<r;i++)
    {for (j=0;j<c;j++)
      {cout<<matrix1[i][j]<<" ";
      }cout<<"\n";
    }
      cout<<"\nEnter matrix 2nd \n";
      for (i=0;i<r;i++)
        { for (j=0;j<c;j++)
        {cin>>matrix2[i][j];
        }
        }
      cout<<"Entered matrix is\n";
      for (i=0;i<r;i++)
        { for (j=0;j<c;j++)
        {cout<<matrix2[i][j]<<" ";
        }cout<<"\n";
        }
      cout<<"\nEnter Choice: 1 = Addition 2 = Subtraction\n";
      cin>>choice;
      if(choice==1)
        { cout<<"Addition of matrix \n";
    for (i=0;i<r;i++)
      { for (j=0;j<c;j++)
        { sum[i][j]=matrix1[i][j]+matrix2[i][j];
          cout<<sum[i][j]<<" ";
        }cout<<"\n";
      }
        }
      if(choice==2)
        { cout<<"Subtraction of matrix \n";
          for (i=0;i<r;i++)
      { for (j=0;j<c;j++)
        { sub[i][j]=matrix1[i][j]-matrix2[i][j];
          cout<<sub[i][j]<<" ";
        }cout<<"\n";
      }
        }
getch();

}
```
// PATTERNS DISPLAY
 1
 2 3
 4 5 6
 7 8 9 10
11 12 13 14 15

Code:
```cpp
#include<iostream.h>
#include<conio.h>
void main()
{
```

```cpp
    int i,j,k,row;
    clrscr();
    k=1;
    cout<<"Enter the no. of rows you want:\n";
    cin>>row;
    for(i=1;i<=row;i++)
    {
      for(j=row;j>=1;j--)
      {
        if(j>i)
   cout<<" ";
        else
   cout<<k++;
      }
      cout<<"\n";
    }
    getch();
}
```

1
2 2
3 3 3
4 4 4 4
5 5 5 5 5
Code:
```cpp
#include<iostream.h>
#include<conio.h>
void main()
{
    int i,j;
    clrscr();
    cout<<"Enter the number of rows you want:\n";
    cin>>row;
    for(i=1;i<=row;i++)
    {
   for(j=1;j<=i;j++)
   {
      cout<<i;
   }
  cout<<"\n";
    }
    getch();
}
```

1
2 6
3 7 10
4 8 11 13
5 9 12 14 15

Code:
```cpp
#include<iostream.h>
#include<conio.h>
```

```
void main()
{
  int i,j,k,row;
  clrscr();
  cout<<"Enter the number of rows you want:\n";
  cin>>row;
  for(i=1;i<=row;i++)
  {
    k = i;
    for(j=1;j<=i;j++)
    {
      cout<<k;
      k += row-j;
    }
    cout<<"\n";
  }
 getch();
}
```

```
   1
  2 3
 4 5 6
7 8 910
1112131415
```

Code:
```
#include<iostream.h>
#include<conio.h>
void main()
{
  int i,j,k,row;
  clrscr();
  k=1;
  cout<<"Enter the no. of rows you want:\n";
  cin>>row;
  for(i=1;i<=row;i++)
  {
    for(j=row;j>=1;j--)
    {
      if(j>i)
 cout<<" ";
      else
 cout<<k++;
    }
    cout<<"\n";
  }
  getch();
}
```

```
1
0 1
0 0 1
0 0 0 1
```

0 0 0 0 1

Code:
```
#include<iostream.h>
#include<conio.h>
void main()
{
 int i,j,row;
 clrscr();
 cout<<"Enter the number of rows you want:\n";
 cin>>row;
 cout<<"\n";
 for(i=1;i<=row;i++)
 {
  for(j=1;j<=i;j++)
  {
   cout<<j/i;
  }
  cout<<"\n";
 }
 getch();
}
```

```
*
**
***
****
*****
```

Code:
```
#include<iostream.h>
#include<conio.h>

void main()
{int row,i,j;
 clrscr();
 cout<<"Enter the number of rows you want: \n";
 cout<<row;
 for(i=1;i<=row;i++)
 {
  for(j=1;j<=i;j++)
  {
   cout<<"* ";
  }
  cout<<"\n";
 }
 getch();
}
```

```
    *
   **
  ***
 ****
*****
```

Code:
```
#include<iostream.h>
```

```
#include<conio.h>
void main()
{
 int i, j, k, row;
 clrscr();
 cout<<"Enter the number of rows you want:\n";
 cin>>row;
 for(i=row;i>=1;i--)
 {
  for(j=1;j<i;j++)
  {
   cout<<" ";
  }
  for(k=row;k>=i;k--)
  {
   cout<<"*";
  }
  cout<<"\n";
 }
 getch();
}
```

```
*****
****
***
**
*
```

 Code:
```
#include<iostream.h>
#include<conio.h>
void main()
{
 int i, j, k, row;
 clrscr();
 cout<<"Enter the number of rows you want:\n";
 cin>>row;
 for(i=row;i>=1;i--)
 {
  for(j=row;j>i;j--)
  {
   cout<<" ";
  }
  for(k=1;k<=i;k++)
  {
   cout<<"*";
  }
  cout<<"\n";
 }
 getch();
}
```

```
    *
   ***
  *****
 *******
********
```

Code:
```cpp
#include<iostream.h>
#include<conio.h>
void main()
{
 int i,j,k,row;
 clrscr();
 cout<<"Enter the number of rows you want:\n";
 cin>>row;
 for(i=1;i<=row;i++)
 {
  for(j=i;j<row;j++)
  {
   cout<<" ";
  }
  for(k=1;k<(i*2);k++)
  {
   cout<<"*";
  }
  cout<<"\n";
 }
 getch();
}
```

```
*********
 *******
  *****
   ***
    *
```

Code:
```cpp
#include<iostream.h>
#include<conio.h>
void main()
{
 int i,j,k,row;
 clrscr();
 cout<<"Enter the number of rows you want:\n";
 cin>>row;
 for(i=row;i>=1;i--)
 {
  for(j=row;j>i;j--)
  {
   cout<<" ";
  }
  for(k=1;k<(i*2);k++)
  {
   cout<<"*";
  }
  cout<<"\n";
 }
 getch();
}
```

```
*********
```

```
**** ****
***   ***
**     **
*       *
```
 Code:
```cpp
#include<iostream.h>
#include<conio.h>
void main()
{
 int row,i,j;
 clrscr();
 cout<<"Enter the number of rows you want: \n";
 cin>>row;
 for(i=row;i>=1;i--)
 {
  for(j=1;j<=i;j++)
  {
   cout<<"*";
  }
  for(j=row;j>=1;j--)
   {
     if(j<=i)
     {
   cout<<"*";
     }
     else
     {
   cout<<"  ";
     }
    }
  cout<<"\n";
 }
 getch();
}
```

```
*       *
**     **
***   ***
**** ****
*********
```
 Code:
```cpp
#include<iostream.h>
#include<conio.h>
void main()
{
  int i,j,k,row;
  clrscr();
  cout<<"Enter the number of rows you want:\n";
  cin>>row;
  cout<<"\n";
  for(i=1;i<=row;i++)
  {
    for(j=1;j<=row;j++)
    {
      if(j<=i)
```

```cpp
        {
         cout<<"*";
        }
        else
        {
         cout<<" ";
        }
       }
      for(j=row;j>=1;j--)
       {
        if(j<=i)
       {
         cout<<"*";
        }
        else
       {
         cout<<" ";
        }
       }
      cout<<"\n";
     }
    getch();
   }
```

```
    *
   ***
  *****
 *******
********
 *******
  *****
   ***
    *
```

Code:
```cpp
#include<iostream.h>
#include<conio.h>
void main()
{
 int i,j,k;
 clrscr();
 for(i=1;i<=5;i++)
 {
 for(j=i;j<5;j++)
 {
  cout<<" ";
 }
 for(k=1;k<(i*2);k++)
 {
  cout<<"*";
 }
  cout<<"\n";
 }
 for(i=4;i>=1;i--)
 {
```

```
    for(j=5;j>i;j--)
    {
     cout<<" ";
    }
    for(k=1;k<(i*2);k++)
    {
     cout<<"*";
    }
    cout<<"\n";
   }
   getch();
}
```

 Code:
```
#include<iostream.h>
#include<conio.h>
void main()
{
 int i,j,k;
 clrscr();
 for(i=1;i<=5;i++)
 {
  for(j=1;j<=6-i;j++)
  {
   cout<<"*";
  }
  for(k=1;k<i;k++)
  {
   cout<<"  ";
  }
  for(j=1;j<=6-i;j++)
  {
   cout<<"*";
  }
  cout<<"\n";
 }
 for(i=2;i<=5;i++)
 {
  for(j=1;j<=i;j++)
     cout<<"*";
  for(k=1;k<=5-i;k++)
  {
   cout<<"  ";
  }
  for(j=1;j<=i;j++)
```

```cpp
    {
    cout<<"*";
    }
    cout<<"\n";
    }
    getch();
}
```
// fibonnacci series
```cpp
#include<iostream.h>
#include<conio.h>
void main()
{ clrscr();
    int a=0,b=1,c;
    cout<<"Fibonacci Series Output\n";
    cout<<"Series :- "<<a<<" "<<b;
    for(int i=0;i<=15;i++)
     {c=a+b;
      cout<<" "<<c;
      a=b;
      b=c;
      }
getch();
}
```


//convert uupercase to lowercase string and viceversa
```cpp
#include<iostream.h>
#include<string.h>
#include<conio.h>
void main()
{ clrscr();
  char str1[30],temp[30];
  cout<<"Convert Lower to Upper case & Vice versa \n";
  cout << "Enter the string: ";
  cin >> str1;
  strcpy(temp,str1);
  cout<<"Upper Case String "<<strupr(temp) ;
  cout<<"\nLower Case String "<<strlwr(temp) ;
getch();
}
//ascii code
#include <iostream.h>
#include<conio.h>
void main()
{      clrscr();
 char ascii;
 cout << "Give character: ";
 cin >> ascii;
 cout << "Its ascii value is: "<< (int) ascii ;
     getch();
```

Computer Fundamentals

Objective:

❖ **To impart in-depth knowledge of computer related basic terminologies.**

❖ **To inculcate the skills of implementation of basic theory in troubleshooting the software & hardware problems.**

What is Computer?

Computer is an advanced electronic device that takes raw data as input from the user and processes these data under the control of set of instructions (called program) and gives the result (output) and saves output for the future use. It can process both numerical and non-numerical (arithmetic and logical) calculations.

A computer has four functions:	**Input**
a. accepts data	
b. processes data	**Processing**
c. produces output	**Output**
d. stores results	**Storage**

Input (Data):

Input is the raw information entered into a computer from the input devices. It is the collection of letters, numbers, images etc.

Process:

Process is the operation of data as per given instruction. It is totally internal process of the computer system.

Output:

Output is the processed data given by computer after data processing. Output is also called as Result. We can save these results in the storage devices for the future use.

Computer System

All of the components of a computer system can be summarized with the simple equations. COMPUTER SYSTEM = HARDWARE + SOFTWARE+ USER

- Hardware = Internal Devices + Peripheral Devices
    All physical parts of the computer (or everything that we can touch) are known as Hardware.
- Software = Programs
    Software gives "intelligence" to the computer.
- USER = Person, who operates computer.

Generation of computer:

First Generation (1940-56):
The first generation computers used vaccum tubes & machine language was used for giving the instructions. These computer were large in size & their programming was difficult task. The electricity

consumption was very high. Some computers of this generation are ENIAC, EDVAC, EDSAC & UNIVAC-1.

Second Generation(1956-63):

In 2nd generation computers, vaccum tubes were replaced by transistors. They required only 1/10 of power required by tubes. This generation computers generated less heat & were reliable. The first operating system developed in this generation.

The Third Generation(1964-71):

The 3rd generation computers replaced transistors with Integrated circuit known as chip. From Small scale integrated circuits which had 10 transistors per chip, technology developed to MSI circuits with 100 transistors per chip. These computers were smaller, faster & more reliable. High level languages invented in this generation.

The fourth Generation(1972- present):

LSI & VLSI were used in this generation. As a result microprocessors came into existence. The computers using this technology known to be Micro Computers. High capacity hard disk were invented. There is great development in data communication.

The Fifth Generation (Present & Beyond):

Fifth generation computing devices, based on artificial intelligence, are still in development, though there are some applications, such as voice recognition, that are being used today. The use of parallel processing and superconductors is helping to make artificial intelligence a reality. Quantum computation and molecular and nanotechnology will radically change the face of computers in years to come.

ARCHITECTURE OF COMPUTER
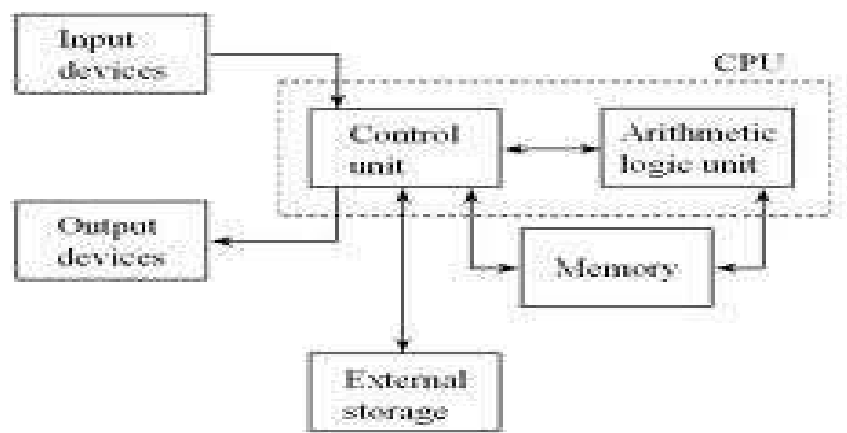
Input Devices: Those devices which help to enter data into computer system. Eg. Keyboard, Mouse, Touchscreen, Barcode Reader, Scanner, MICR, OMR etc.

Bar code Reader   MICR used in Bank   OMR(Used for answer sheet evaluation)

Output Devices: Those devices which help to display the processed information. Eg. Monitor, Printer, Plotter, Projector

Printer   Plotter   Projector

CENTRAL PROCESSING UNIT (CPU)

The main component to make a computer operate is the computer chip or microprocessor. This is referred to as the Central Processing Unit (CPU) and is housed in the computer case. Together, they are also called the CPU. It performs arithmetic and logic operations. The CPU (Central Processing Unit) is the device that interprets and executes instructions.

Processor

Memory: It facilitates the remembrance power to computer system. It refers to the physical devices used to store programs (sequences of instructions) or data (e.g. program state information) on a temporary or permanent basis for use in a computer or other digital electronic device. The term primary memory is used for the information in physical systems which are fast (i.e. RAM), as a distinction from secondary memory, which are physical devices for program and data storage which are slow to access but offer higher memory capacity. Primary memory stored on secondary memory is called virtual memory. Primary Memory can be categorized as Volatile Memory & Non-Volatile Memory.

Volatile memory(RAM)

Volatile memory is computer memory that requires power to maintain the stored information. Most modern semiconductor volatile memory is either Static RAM or dynamic RAM.

SRAM retains its contents as long as the power is connected and is easy to interface to but uses six transistors per bit.

Dynamic RAM is more complicated to interface to and control and needs regular refresh cycles to prevent its contents being lost. However, DRAM uses only one transistor and a capacitor per bit, allowing it to reach much higher densities and, with more bits on a memory chip, be much cheaper per bit. SRAM is not worthwhile for desktop system memory, where DRAM dominates, but is used for their cache memories..

Non Volatile Memory (ROM)

Non-volatile memory is computer memory that can retain the stored information even when not

powered.
Examples of non-volatile memory are flash memory and ROM/PROM/EPROM/EEPROM memory (used for firmware such as boot programs).

Cache Memory:

Cache memory is random access memory (RAM) that a computer microprocessor can access more quickly than it can access regular RAM. As the microprocessor processes data, it looks first in the cache memory and if it finds the data there (from a previous reading of data), it does not have to do the more time-consuming reading of data from larger memory. It is of two types- L1 cache is on the same chip as the microprocessor. L2 is usually a separate static RAM (SRAM) chip.

Secondary Memory:
        A. Hard Disk (Local Disk)
        B. Optical Disks: CD-R, CD-RW, DVD-R, DVD-RW
        C. Pen Drive
        D. Floppy Disks
        F. Memory Cards
        G. External Hard Disk
        H. Blu Ray Disk

Blu-Ray Disk:

Blu-ray (not Blue-ray) also known as Blu-ray Disc (BD), is the name of a new optical disc format. The format offers more than five times the storage capacity of traditional DVDs and can hold up to 25GB on a single-layer disc and 50GB on a dual-layer disc. While current optical disc technologies such as DVD, DVD±R, DVD±RW, and DVD-RAM rely on a red laser to read and write data, the new format uses a blue-violet laser instead, hence the name Blu-ray.

Units of Memory:

The smallest unit is bit, which mean either 0 or 1.

1 bit = 0 or 1
1 Byte = 8 bit
1 Nibble = 4 bit
1 Kilo Byte = 1024 Byte= 2^{10} Byte
1 Mega Byte = 1024 KB= 2^{10} KB
1 Gega Byte = 1024 MB= 2^{10} MB
1 Tera Byte = 1024 GB= 2^{10} GB
1 Peta Byte =1024 TB= 2^{10} TB
1 Exa Byte =1024 PB= 2^{10} PB
1 Zetta Byte = 1024 EB= 2^{10} EB
1 Yotta Byte = 1024 ZB= 2^{10} ZB

Booting

The process of loading the system files of the operating system from the disk into the computer memory to complete the circuitry requirement of the computer system is called booting.

Types of Booting:

There are two types of booting:

  • **Cold Booting:** If the computer is in off state and we boot the computer by pressing the power switch ‗ON' from the CPU box then it is called as cold booting.

- **Warm Booting:** If the computer is already _ON' and we restart it by pressing the _RESET' button from the CPU box or CTRL, ALT and DEL key simultaneously from the keyboard then it is called warm booting.

Types of Computer

On the basis of working principle

a) Analog Computer

An analog computer is a form of computer that uses *continuous* physical phenomena such as electrical, mechanical, or hydraulic quantities to model the problem being solved.

Eg: Thermometer, Speedometer, Petrol pump indicator, Multimeter

b) Digital Computer

A computer that performs calculations and logical operations with quantities represented as digits, usually in the binary number system.

c) Hybrid Computer (Analog + Digital)

A combination of computers those are capable of inputting and outputting in both digital and analog signals. A hybrid computer system setup offers a cost effective method of performing complex simulations. The instruments used in medical science lies in this category.

On the basis of Size

a) Super Computer
The fastest type of computer. Supercomputers are very expensive and are employed for specialized applications that require immense amounts of mathematical calculations. For example, weather forecasting requires a supercomputer. Other uses of supercomputers include animated graphics, fluid dynamic calculations, nuclear energy research, and petroleum exploration. PARAM, Pace & Flosolver are the supercomputer made in india.

b) Mainframe Computer

A very large and expensive computer capable of supporting hundreds, or even thousands, of users simultaneously. In the hierarchy that starts with a simple microprocessor (in watches, for example) at the bottom and moves to supercomputers at the top, mainframes are just below supercomputers. In some ways, mainframes are more powerful than supercomputers because they support more simultaneous programs. But supercomputers can execute a single program faster than a mainframe.

c) Mini Computer

A midsized computer. In size and power, minicomputers lie between *workstations* and *mainframes*. In the past decade, the distinction between large minicomputers and small mainframes has blurred, however, as has the distinction between small minicomputers and workstations. But in general, a minicomputer is a multiprocessing system capable of supporting from 4 to about 200 users simultaneously. Generally, servers are comes in this category.

d) Micro Computer

  i. **Desktop Computer:** a personal or micro-mini computer sufficient to fit on a desk.

  ii. **Laptop Computer:** a portable computer complete with an integrated screen and keyboard. It is generally smaller in size than a desktop computer and larger than a notebook computer.

  iii. **Palmtop Computer/Digital Diary /Notebook /PDAs:** a hand-sized computer. Palmtops have no keyboard but the screen serves both as an input and output device.

e) Workstations

A terminal or desktop computer in a network. In this context, workstation is just a generic term for a user's machine (client machine) in contrast to a "server" or "mainframe."
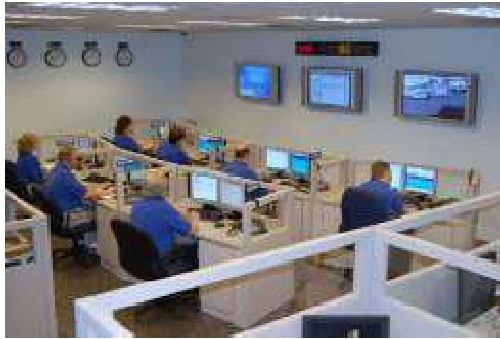
Software, simply are the computer programs. The instructions given to the computer in the form of a program is called Software. Software is the set of programs, which are used for different purposes. All the programs used in computer to perform specific task is called Software.

Types of software

1. **System software:**

  a) Operating System Software
  DOS, Windows XP, Windows Vista, Unix/Linux, MAC/OS X etc.
  b) Utility Software
  Windows Explorer (File/Folder Management), Compression Tool, Anti-Virus Utilities, Disk Defragmentation, Disk Clean, BackUp, WinZip, WinRAR etc…
  c) Language Processors
  Compiler, Interpreter and Assembler

2. **Application software:**

  a) Package Software
  Ms. Office 2003, Ms. Office 2007, Macromedia (Dreamweaver, Flash, Freehand), Adobe (PageMaker, PhotoShop)
  b) Tailored or Custom Software
  School Management system, Inventory Management System, Payroll system, financial system etc.

Operating system

Operating system is a platform between hardware and user which is responsible for the management and coordination of activities and the sharing of the resources of a computer. It hosts the several applications that run on a computer and handles the operations of computer hardware.

Functions of operating System:
- Processor Management
- Memory Management
- File Management
- Device Management

Types of Operating System:

- **Real-time Operating System:** It is a multitasking operating system that aims at executing real-time applications. Example of Use: e.g. control of nuclear power plants, oil refining, chemical processing and traffic control systems, air

- **Single User Systems:** Provides a platform for only one user at a time. They are popularly associated with Desk Top operating system which run on standalone systems where no user accounts are required. Example: DOS.
- **Multi User Systems:** Provides regulated access for a number of users by maintaining a database of known users. Refers to computer systems that support two or more simultaneous users. Another term for multi-user is time sharing. Ex: All mainframes are multi-user systems. Example: Unix

- **Multi-tasking and Single-tasking Operating Systems:** When a single program is allowed to run at a time, the system is grouped under the single-tasking system category, while in case the operating system allows for execution of multiple tasks at a time, it is classified as a multi-tasking operating system.
- **Distributed Operating System:** An operating system that manages a group of independent computers and makes them appear to be a single computer is known as a distributed operating system. Distributed computations are carried out on more than one machine. When computers in a group work in cooperation, they make a distributed system.

Commonly used operating system

UNIX: Pronounced *yoo-niks,* a popular *multi-user*, *multitasking* operating system **developed** at Bell Labs in the early 1970s. UNIX was one of the first operating systems to be written in a high-level programming language, namely C. This meant that it could be installed on virtually any computer for which a C compiler existed.

LINUX: Pronounced *lee-nucks* or *lih-nucks*. A freely-distributable open source operating system that runs on a number of hardware platforms. The Linux kernel was developed mainly by Linus Torvalds and it is based on Unix. Because it's free, and because it runs on many platforms, including PCs and Macintoshes, Linux has become an extremely popular alternative to proprietary operating systems.

Windows: Microsoft Windows is a series of graphical interface operating systems developed, marketed, and sold by Microsoft. Microsoft introduced an operating environment named *Windows* on November 20, 1985 as an add-on to MS-DOS in response to the growing interest in graphical user interfaces (GUIs). [2] Microsoft Windows came to dominate the world's personal computer market with over 90% market share, overtaking Mac OS, which had been introduced in 1984. The most recent client version of Windows is Windows 7; the most recent server version is Windows Server 2008 R2; the most recent mobile version is Windows Phone 7.5.

SOLARIS: Solaris is a Unix operating system originally developed by Sun Microsystems. It superseded their earlier SunOS in 1993. **Oracle Solaris**, as it is now known, has been owned by Oracle Corporation since Oracle's acquisition of Sun in January 2010.

BOSS: BOSS (Bharat Operating System Solutions) GNU/Linux distribution developed by C-DAC (Centre for Development of Advanced Computing) derived from Debian for enhancing the use of Free/ Open Source Software throughout India. This release aims more at the security part and comes with an easy to use application to harden your Desktop.

Mobile OS: A mobile operating system, also called a mobile OS, is an operating system that is specifically designed to run on mobile devices such as mobile phones, smartphones, PDAs, tablet computers and other handheld devices. The mobile operating system is the software platform on top of which other programs, called application programs, can run on mobile devices.

- **Android:** Android **is** a Linux-based mobile phone operating system developed by Google. Android is unique because Google is actively developing the platform but giving it away for free to hardware manufacturers and phone carriers who want to use Android on their devices.

- **Symbian:** Symbian is a mobile operating system (OS) targeted at mobile phones that offers a high-level of integration with communication and personal information management (PIM) functionality. Symbian OS combines middleware with wireless communications through an integrated mailbox and the integration of Java and PIM functionality (agenda and contacts). The Symbian OS is open for third-party development by independent software vendors, enterprise IT departments, network operators and Symbian OS licensees.

LANGUAGE PROCESSORS: Since a computer hardware is capable of understanding only machine level instructions, So it is necessary to convert the HLL into Machine Level Language. There are three Language processors:

A. **Compiler:** It is translator which coverts the HLL language into machine language in one go. A Source program in High Level Language get converted into Object Program in Machine Level Language.
B. **Interpreter:** It is a translator which converts the HLL language into machine language line by line. It takes one statement of HLL and converts it into machine code which is immediately executed. It eliminate the need of separate compilation/run. However, It is slow in processing as compare to compiler.
C. **Assembler:** It translate the assembly language into machine code.

Microprocessor:

A microprocessor is a semiconductor chip, which is manufactured using the Large Scale integration (LSI) or Very Large Scale Integration (VLSI), which comprises Arithmetic Logic Unit, Control unit and Central Processing Unit (CPU) fabricated on a single chip.

Terminologies:

Registers: A register is a very small amount of very fast memory that is built into the CPU (central processing unit) in order to speed up its operations by providing quick access to commonly used values. All data must be represented in a register before it can be processed. For example, if two numbers are to be multiplied, both numbers must be in registers, and the result is also placed in a register.

Bus:

A collection of wires through which data is transmitted from one part of a computer to another. You can think of a bus as a highway on which data travels within a computer. When used in reference to personal computers, the term *bus* usually refers to *internal bus*. This is a bus that connects all the internal computer components to the CPU and main memory. All buses consist of two parts -- an address bus and a data bus. The data bus transfers actual data whereas the address bus transfers information about where the data should go. The control bus is used by the CPU to direct and monitor the actions of the other functional areas of the computer. It is used to transmit a variety of individual signals (read, write, interrupt, acknowledge, and so forth) necessary to control and coordinate the operations of the computer.

The size of a bus, known as its *width,* is important because it determines how much data can be transmitted at one time. For example, a 16- bit bus can transmit 16 bits of data, whereas a 32-bit bus can transmit 32 bits
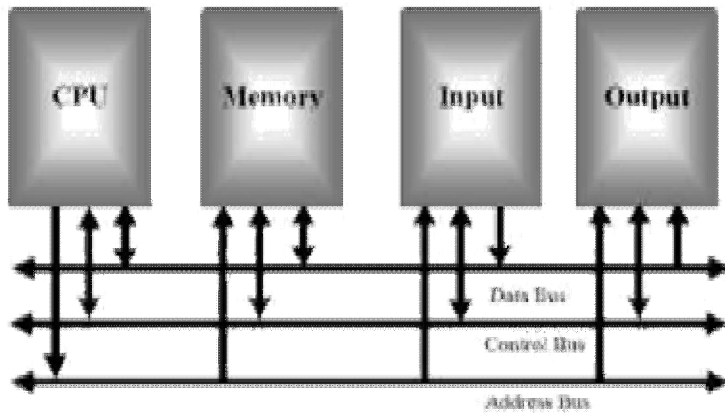
Clock speed: Also called *clock rate,* the speed at which a microprocessor executes instructions. Every computer contains an internal clock that regulates the rate at which instructions are executed and synchronizes all the various computer components. The CPU requires a fixed number of clock ticks (or *clock cycles*) to execute each instruction. The faster the clock, the more instructions the CPU can execute per second.

Clock speeds are expressed in megahertz (MHz) or gigahertz ((GHz).

16 bit Microprocessor: It indicates the width of the registers. A 16-bit microprocessor can process data and memory addresses that are represented by 16 bits. Eg. 8086 processor
32 bit Microprocessor: It indicates the width of the registers. A 32-bit microprocessor can process data and memory addresses that are represented by 32 bits. Eg. Intel 80386 processor, Intel 80486
64 bit Microprocessor: It indicates the width of the registers; a special high-speed storage area within the CPU. A 32-bit microprocessor can process data and memory addresses that are represented by 32 bits. Eg. Pentium dual core, core 2 duo.
128 bit Microprocessor: It indicates the width of the registers. A 128-bit microprocessor can process data and memory addresses that are represented by 128 bits. Eg. Intel core i7

Difference between RISC & CISC architecture

RISC *(Reduced Instruction Set Computing):*
1. RISC sytem has reduced number of instructions.
2. Performs only basic functions.
3. All HLL support is done in software.
4. All operations are register to register.

CISC (Complex *Instruction Set Computing):*
1. A large and varied instruction set.
2. Performs basic as well as complex functions.
3. All HLL support is done in Hardware.
4. Memory to memory addressing mode

EPIC (Explicitly Parallel Instruction Computing):

It is a 64-bit microprocessor instruction set, jointly defined and designed by Hewlett Packard and Intel, that provides up to 128 general and floating point unit registers and uses *speculative loading*, *predication*, and *explicit parallelism* to accomplish its computing tasks. By comparison, current 32-bit CISC and RISC microprocessor architectures depend on 32-bit registers, branch prediction, memory latency, and implicit parallelism, which are considered a less efficient approach in microarchitecture design.

PORTS: A port is an interface between the motherboard and an external device. Different types of port are available on motherboard as serial port, parallel port, PS/2 port, USB port, SCSI port etc.

Serial port(COM Port): A serial port transmit data one bit at a time. Typically on older PCs, a modem, mouse, or keyboard would be connected via serial ports. Serial cables are cheaper to make than parallel cables and easier to shield from interference. Also called communication port.

Parallel Port (LPT ports): It supports parallel communication i.e. it can send several bits simultaneously.It provides much higher data transfer speed in comparison with serial port. Also called Line Printer Port.

USB (Universal Serial Bus): It is a newer type of serial connection that is much faster than the old serial ports. USB is also much smarter and more versatile since it allows the "daisy chaining" of up to 127 USB peripherals connected to one port. It provides plug & play communication.

PS/2 Port : PS/2 ports are special ports for connecting the keyboard and mouse to some PC systems. This type of port was invented by IBM

FireWire Port : The IEEE 1394 interface, developed in late 1980s and early 1990s by Apple as FireWire, is a serial bus interface standard for high-speed communications and isochronous real-time data transfer. The 1394 interface is comparable with USB and often those two technologies are considered together, though USB has more market share.

Infrared Port: An IR port is a port which sends and receives infrared signals from other devices. It is a wireless type port with a limited range of 5-10ft.

Bluetooth: Bluetooth uses short-range radio frequencies to transmit information from fixed and mobile devices. These devices must be within the range of 32 feet, or 10 meters for Bluetooth to effectively work. A Bluetooth port enables connections for Bluetooth-enabled devices for synchronizing. Typically there are two types of ports: incoming and outgoing. The incoming port enables the device to receive connections from Bluetooth devices while the outgoing port makes connections to Bluetooth devices.

Internal Storage encoding of Characters:

ASCII(American standard code for information interchange): ASCII code is most widely used alphanumeric code used in computers. It is a 7- bit code, and so it has 2^7 =128 possible code groups. It represents all of the standard keyboard characters as well as control functions such as Return & Linefeed functions.

ISCII(American standard code for information interchange) : To use the Indian language on computers, ISCII codes are used. It is an 8-bit code capable of coding 256 characters. ISCII code retains all ASCII characters and offers coding for Indian scripts also.

Unicode: It is a universal coding standard which provides a unique number for every character, no matter what the platform, no matter what the program, no matter what the language. Unicode version 3.1 represented 94,140 characters.

NUMBER SYSTEM:

A. Decimal Number System:
Decimal Number system composed of 10 numerals or symbols. These numerals are 0 to 9. Using these symbols as digits we can express any quantity. It is also called base-10 system. It is a positional value system in which the value of a digit depends on its position.

These digits can represent any value, for example:
754.
The value is formed by the sum of each digit, multiplied by the **base** (in this case it is **10** because there are 10 digits in decimal system) in power of digit position (counting from zero):

$$7 \cdot \boxed{10}^2 + 5 \cdot 10^1 + 4 \cdot 10^{\boxed{0}} = 700 + 50 + 4 = 754$$

base

digit position

Decimal numbers would be written like this:
$127_{10} \ 111_{10} \ 5673_{10}$

B. Binary Number System:

In Binary Number system there are only two digits i.e. 0 or 1. It is base-2 system. It can be used to represent any quantity that can be represented in decimal or other number system. It is a positional value system, where each binary digit has its own value or weight expressed as power of 2.

The following are some examples of binary
numbers: $101101_2 \ 11_2 \ 10110_2$

Conversion from Decimal to Binary or Binary to Decimal

Convert from decimal to binary $X_{(10)} \rightarrow X_{(2)}$

Integer

$45_{(10)} \rightarrow X_{(2)}$

Div	Quotient	Remainder	Binary Number (X)
45 / 2	22	1	**1**
22 / 2	11	0	**0**1
11 / 2	5	1	**1**01
5 / 2	2	1	**1**101
2 / 2	1	0	**0**1101
1 / 2	0	1	**1**01101

$45_{(10)} \rightarrow 101101_{(2)}$

Fractional Part

$0.182_{(10)} \rightarrow X_{(2)}$

Div	Product	Integer value	Binary Number (X)
0.182 * 2	0.364	0	0.**0**
0.364 * 2	0.728	0	0.0**0**
0.728 * 2	1.456	1	0.00**1**
0.456 * 2	0.912	0	0.001**0**
0.912 * 2	1.824	1	0.0010**1**
0.824 * 2	1.648	1	0.00101**1**
0.648 * 2	1.296	1	0.001011**1**

$0.182_{(10)} \rightarrow 0.0010111_{(2)}$ (After we round and cut the number)

Conversion from Binary to Decimal

Convert from binary to decimal $X_{(2)} \rightarrow X_{(10)}$

$101101.0010111_{(2)} \rightarrow X_{(10)}$

Index the digits of the number

$1^5 0^4 1^3 1^2 0^1 1^0 . 0^{-1} 0^{-2} 1^{-3} 0^{-4} 1^{-5} 1^{-6} 1^{-7}$

Multiply each digit

$1 * 2^5 + 0 * 2^4 + 1 * 2^3 + 1 * 2^2 + 0 * 2^1 + 1 * 2^0 + 0 * 2^{-1} + 0 * 2^{-2} + 1 * 2^{-3} + 0 * 2^{-4} + 1 * 2^{-5} + 1 * 2^{-6} + 1 * 2^{-7} =$

$32 + 0 + 8 + 4 + 0 + 1 + 0 + 0 + 0.125 + 0 + 0.03125 + 0.015625 + 0.007813$

$= 45.179688_{(10)}$

C. Octal Number System:
It has eight unique symbols i.e. 0 to 7. It has base of 8. Each octal digit has its own value or weight expressed as a power of 8.

D. Hexadecimal Number System:
The hexadecimal system uses base 16. It has 16 possible digit symbols. It uses the digits 0 through 9 plus the letters A,B,C,D,E,F as 16 digit symbols. Each hexadecimal digit has its own value or weight expressed as a power of 16.

Table to remember

Decimal	Binary	Hexadecimal	Octal
0	0	0	0
1	1	1	1
2	10	2	2
3	11	3	3
4	100	4	4
5	101	5	5
6	110	6	6
7	111	7	7
8	1000	8	10
9	1001	9	11
10	1010	A	12
11	1011	B	13
12	1100	C	14
13	1101	D	15
14	1110	E	16
15	1111	F	17
16	10000	10	20

Convert from decimal to octal $X_{(10)} -> X_{(8)}$

Integer

$45_{(10)} -> X_{(8)}$

Div	Quotient	Remainder	Octal Number (X)
45 / 8	5	5	**5**
5 / 8	0	5	**5**5

$45_{(10)} \rightarrow 55_{(8)}$

Fractional Part

$0.182_{(10)} \rightarrow X_{(8)}$

Mul	Product	Integer	Binary Number (X)
0.182 * 8	1.456	1	0.**1**
0.456 * 8	3.648	3	0.1**3**
0.648 * 8	5.184	5	0.13**5**
0.184 * 8	1.472	1	0.135**1**
0.472 * 8	3.776	3	0.1351**3**
0.776 * 8	6.208	6	0.13513**6**

$0.182_{(10)} \rightarrow 0.135136_{(8)}$ (After we round and cut the number)

Convert from decimal to hexadecimal $X_{(10)} \rightarrow X_{(16)}$

Integer

$45_{(10)} \rightarrow X_{(16)}$

Div	Quotient	Remainder	Hex Number (X)
45 / 16	2	13	**D** (Since 13 decimal is D in hexadecimal)
2 / 16	0	2	**2**D (See the table)

$45_{(10)} \rightarrow 2D_{(16)}$

Fractional Number

$0.182_{(10)} \rightarrow X_{(16)}$

Mul	Product	Integer	Binary Number (X)
0.182 * 16	2.912	2	0.**2**
0.912 * 16	14.592	14	0.2**E**
0.592 * 16	9.472	9	0.2E**9**
0.472 * 16	7.552	7	0.2E9**7**

22

| 0.552 * 16 | 8.832 | 8 | 0.2E978**8** |
| 0.832 * 16 | 13.312 | 13 | 0.2E978**D** |

$0.182_{(10)} \rightarrow 0.2E978D_{(16)}$ (After we round and cut the number)

Convert from octal to decimal $X_{(8)} \rightarrow X_{(10)}$

$55.135136_{(8)} \rightarrow X_{(10)}$

<u>Index the digits of the number</u>

$5^1 5^0 . 1^{-1} 3^{-2} 5^{-3} 1^{-4} 3^{-5} 6^{-6}$

<u>We multiply each digit</u>

$5 * 8^1 + 5 * 8^0 + 1 * 8^{-1} + 3 * 8^{-2} + 5 * 8^{-3} + 1 * 8^{-4} + 3 * 8^{-5} + 6 * 8^{-6} =$

$40 + 5 + 0.125 + 0.03125 + 0.009766 + 0.000244 + 0.0001 + 0.0000229$

$= 45.1663829_{(10)}$

Convert from hexadecimal to decimal $X_{(16)} \rightarrow X_{(10)}$

$2D.2E978D_{(16)} \rightarrow X_{(10)}$

<u>Index the digits of the number</u>

$2^1 13^0 . 2^{-1} 14^{-2} 9^{-3} 7^{-4} 8^{-5} 13^{-6}$

<u>We multiply each digit</u>

$2 * 16^1 + 13 * 16^0 + 2 * 16^{-1} + 14 * 16^{-2} + 9 * 16^{-3} + 7 * 16^{-4} + 8 * 16^{-5} + 13 * 16^{-6} = 32$

$+ 13 + 0.125 + 0.0546875 + 0.00219727 + 0.00010681 + 0.00000762 + 0.00000077 =$

$45.18199997_{(10)}$

Convert from binary to octal: For this conversion make the group of three digits from right to left before decimal & left to right after decimal then assign the specific octal value. (Given in the table above)

$110101000.101010_{(2)} \rightarrow X_{(8)}$

| 3 | | 3 | | 3 | | 3 | | 3 |

110 101 000 .101 010

‖   ‖   ‖   ‖   ‖

V   V   V   V   V

23

6   5   0 . 5 2   (See that in the array $110_{(2)}$ corresponds to $6_{(8)}$)

$110101000.101010_{(2)}$->$650.52_{(8)}$

Convert from binary to hexadecimal: This conversion make the group of four digits from right to left before decimal & left to right after decimal then assign the specific Hexadecimal value. (Given in the table above)

$110101000.101010_{(2)}$->$X_{(16)}$

| 4 | | 4 | | 4 | | 4 | | 4 |

0001 1010   1000 .1010 1000

|| || || || ||

V   V   V   V   V

1   A   8 . A   8

$110101000_{(2)}$->$1A8.A8_{(16)}$

Convert from hexadecimal to octal and binary: In this conversion write the binary of specific digit. For Octal three digit binary & for Hexadecimal four digit binary.

Convert from octal to binary

$650.52_{(8)}$->$X_{(2)}$

6   5   0 . 5 2

|| || || || ||

V   V   V   V V

110   101 000 . 101 010

$650.52_{(8)}$->$110101000.101010_{(2)}$

Convert from hexadecimal to binary

$1A8.A8_{(16)}$->$X_{(2)}$

1   A   8 . A   8

|| || || || ||

V   V   V V   V

0001 1010 1000 .1010 1000

Practice Session:

1. Which electronic device invention brought revolution in earlier computers? Ans. Microprocessor

2. Which memory is responsible for booting of system.

Ans. ROM

3. Where do you find analog computers in daily life? Ans. In Bike-speedometer, voltmeter

4. What do you mean by term firmware?

Ans. Software (programs or data) that has been written onto read-only memory (ROM). Firmware is a combination of software and hardware. ROMs, PROMs and EPROMs that have data or programs recorded on them are Firmware.

5. What do you mean by language processors? Why we need it? (Do yourself)
6. Give any example of hybrid computer in daily life.

Ans. In medical science- To measure the heart beat, blood pressure etc.

7. Can we think of a computer system without operating system? Justify your answer. (Do yourself)
8. Fifth generation of computer is a symbol of intelligence. Why?
Ans. Due to invention of robotics
9. Which is better for translator & why? Compiler or Interpreter. (Do yourself)
10. What do you mean by Defragmentation? (Do yourself)
11. What do you mean by RISC & CISC? (Do yourself)
12. Which port a mouse should be connected?
Ans. PS/2 port

13. What do you mean by LPT port? Ans. Line Print Terminal

14. What is difference between USB & Firewire Port?
Ans. USB is host based, mean device must connect to computer while Firewire is peer-to-peer. Firewire is sought for high speed devices with more data like camcorders.

15. What is cache memory? (Do yourself)
16. Convert the followings:
    i. 101001.0101 to decimal
    ii. $(236)_8$ to Binary
    iii. $(266)_{10}$ to Hexadecimal
    iv. $(AF2)_{16}$ to Binary
    v. 0101110.1010110 to Hexadecimal

<mark>UNIT-2</mark>
<mark>Introduction to C++</mark>

C++ CHARACTER SET

Character set is asset of valid characters that a language can recognize . A character can represents any letter, digit, or any other sign . Following are some of the C++ character set.

LETTERS   A to Z and a to z
DIGITS   0 -9
SPECIAL SYMBOLS + -* ^ \ [] {} = != < > . _ _ ; : & #
WHITE SPACE   Blankl space , horizontal tab (- >), carriage return , Newline, Form feed.
OTHER CHARACTERS 256 ASCII characters as data or as literals.

<mark>TOKENS:</mark>
The smallest lexical unit in a program is known as token. A token can be any keyword,Identifier,Literals, Puncutators, Operators.

KEYWORDS :
These are the reserved words used by the compiler. Following are some of the Keywords.

auto	continue	float	new	signed	volatile
short long		class	struct	else	inline
delete	friend	private	typedef	void	template
catch	friend	sizeof	union	register	goto

IDENTIFIERS:
An arbitrary name consisting of letters and digits to identify a particular word.C++ is case sensitive as nit treats upper and lower case letters differently. The first character must be a letter . the underscore counts as a letter

Pen time580 s2e2r3   _dos   _HJI3_JK

LITERALS:
The data items which never change their value throughout the program run. There are several kind of literals:
- Integer constant
- Character constant
- Floating constant
- String constant.

Integer constant :
Integer constant are whole numbers without any fractional part. An integer constant must have at least one digit and must not contain any decimal point. It may contain either + or _. A number with no sign is assumed as positive.

e.g 15, 1300, -58795.

Character Constant:
A character constant is single character which is enclosed within single quotation marks.

e.g _A'

Floating constant:

Numbers which are having the fractional part are referred as floating numbers or real constants. it may be a positive or negative number. A number with no sign is assumed to be a positive number.

e.g   2.0, 17.5, -0.00256

String Literals:

It is a sequence of letters surrounded by double quotes. E.g ―abc‖.

PUNCTUATORS:

The following characters are used as punctuators which are also know as separators in C++

[ ]   { } ( ) , ; : * ………. = #

Puntuator	Name	Function
[]	Brackets	These indicates single and multidimensional array subscripts
()	Parenthesis	These indicate function calls and function parameters.
[ ]	Braces	Indicate the start and end of compound statements.
;	Semicolon	This is a statement terminator.
:	Colon	It indicates a labeled statement
*	Asterisk	It is used as a pointer declaration
…	Ellipsis	These are udes in the formal argument lists of unction prototype to indicate a variable number of arguments.
=	Equal to	It is used as an assigning operator.
#	Pound sign	This is used as preprocessor directives.

OPERATORS:

These are those lexical units that trigger some computation when applied to variables and other objects in an expression. Following are some operators used in C++

Unary operators: Those which require only one operand to trigger. e.g. & , + , ++ , -- ! .
Binary operators: these require two operands to operate upon. Following are some of the Binary **operators.**

Arithmatic operators :

+	Addition
_	substraction
A*	Multiplication
/	Division
%	Remainder.

Logical Operators :

&& - logical AND || -   Logical OR

Relational Operator:

< less than
a> Greater than
<= Less than equal to.
>= greater than equal
to. == equal to.
!= not equal to.

Conditional operator: ? (question) : (colon)

<u>**Assignment Operator:**</u>

= assignment operator

*= Assign Product.

/= Assign quotient %=
assign Remainder

&= Assign bitwise AND

^= Assign bitwise XOR.

|=Assign bitwise OR

Conditional operator (?)

The conditional operator evaluates an expression returning a value if that expression is true and a different one if the expression is evaluated as false. Its format is:

condition ? result1 : result2

e.g 7==5 ? 4 : 3   // returns 3, since 7 is not equal to 5.

Comma operator (,)

The comma operator (,) is used to separate two or more expressions that are included where only one expression is expected. When the set of expressions has to be evaluated for a value, only the rightmost expression is considered.

For example, the following code:

a = (b =3 , b +2);

Would first assign the value 3 to b, and then assign b+2 to variable a. So, at the end, variable a would contain the value 5 while variable b would contain value 3.

Explicit type casting operator

Type casting operators allow you to convert a datum of a given type to another. There are several ways to do this in C++. The simplest one, which has been inherited from the C language, is to precede the expression to be converted by the

new type enclosed between parentheses ( ) :

int i;
float f =3014;
i = (int) f;

The previous code converts the float number 3.14 to an integer value (3), the remainder is lost. Here, the typecasting operator was (int). Another way to do the same thing in C++ is using the functional notation: preceding the expression to be converted by the type and enclosing the expression between parentheses:

i = int (f);

Both ways of type casting are valid in C++.

sizeof()

This operator accepts one parameter, which can be either a type or a variable itself and returns the size in bytes of that type or object:

a= sizeof (char);

This will assign the value 1 to a because char is a one-byte long type.
The value returned by sizeof is a constant, so it is always determined before program execution.

Input Output (I/O) In C++

The cout Object:
The cout object sends to the standard output device. cout sends all out put to the screen i.e monitor.
 The syntax of **cout** is as follows:
cout<< data;.
e.g
cout<< a ;   *(here a can be any variable)*

The cin operator :
The cin operator is used to get input from the keyboard. When a program reaches the line with cin, the user at the keyboard can enter values directly into variables.
The syntax of **cin** is as follows:
cin>> variablename
e.g
cin>> ch;   *(here ch can be any variable)*

- ***Basic structure of a C++ program:***

Following is the structure of a C++ program tht prints a string on the screen:
```
#include<iostream.h>
 void main ()
{
cout<<‖ Study material for Class XI‖;
}
```

The program produces following output:
Study material for Class XI

The above program includes the basic elements that every C++ program has. Let us check it line by line

#include<iostream.h> : This line includes the preprocessor directive include which includes the header file iostream in the program.

void main () :this line is the start of compilation for this program. Every C++ programs compilation starts with the **main (). void** is the keyword used when the function has no return values.

{ : this is the start of the compound block of main ().
cout<<‖ Study material for class XI‖;: this statement prints the sequence of string **" Study material for class XI"** into this output stream i..e on monitor.
Every statement in the block will be terminated by a semicolon (;) which specifies compiler the end of statement.

COMMENTS in a C++ program.:

Comments are the line that compiler ignores to compile or execute. There are two types of comments in C++.
1. **Single line comment:** This type of comment deactivates only that line where comment is applied. Single line comments are applied with the help of — //‖ .
    e.g   // cout<<tomorrow is holiday
    the above line is proceeding with // so compiler wont access this line.

2. **Multi line Comment :** This Type of comment deactivates group of lines when applied. This type of comments are applied with the help of the operators —/*‖ and —*/ ‖. These comment mark with /* and end up with */. This means every thing that falls between /*and */ is considered even though it is spread across many lines.

```
e.g   #include<iostream.h>
       int main ()
{
 cout<< —  hello world‖;
 /* this is the program to print hello world
     For demonstration of comments */
}
```

In the above program the statements between **/*** and ***/** will be ignored by the compiler.

CASCADING OF OPERATOR:
When shift operators (**<<** and **>>**) are used more than one time in a single statement then it is called as cascading of operators.
e.g   cout<< roll<< age<< endl;

DATATYPES IN C++:
A datatype is just an interpretation applied to a string of bytes. Data in C++ are of two types:
1.Simple /Fundamental datatypes .
2.Structures/Derived datatypes.

Simple /Fundamental data types:

When programming, we store the variables in our computer's memory, but the computer has to know what kind of data we want to store in them, since it is not going to occupy the same amount of memory to store a simple number than to store a single letter or a large number, and they are not going to be interpreted the same way.

The memory in our computers is organized in bytes. A byte is the minimum amount of memory that we can manage in C++. A byte can store a relatively small amount of data: one single character or a small integer (generally an integer between 0 and 255). In addition, the computer can manipulate more complex data types that come from grouping several bytes, such as long numbers or non-integer numbers.

Next you have a summary of the basic fundamental data types in C++, as well as the range of values that can be represented with each one:

Name	Description	Size	Range
char	Character or small integer.	1byte	signed: -128 to 127 unsigned: 0 to 255
short int (short)	Short Integer.	2bytes	signed: -32768 to 32767 unsigned: 0 to 65535
int	Integer.	4bytes	signed: -2147483648 to 2147483647 unsigned: 0 to 4294967295
long int (long)	Long integer.	4bytes	signed: -2147483648 to 2147483647 unsigned: 0 to 4294967295
float	Floating point number.	4bytes	+/- 3.4e +/- 38 (~7 digits)
double	Double precision floating point number.	8bytes	+/- 1.7e +/- 308 (~15 digits)
long double	Long double precision floating point number.	8bytes	+/- 1.7e +/- 308 (~15 digits)

Derived Data Types:

The datatypes which are extracted / derived from fundamental data types are called derived datatypes. These datatypes can be derived by using the declaration operator or punctuators for e.g Arrays, function, Pointer, Class , Structure, union etc.

Class : A class represents a group of similar objects. To represent class in C++ it offers a user defined datatypes called CLASS .Once a Class has been defined in C++, Object belonging to that class can easily be created. A Class bears the same relationship to an object that a type does to a variable.
Syntax of CLASS:
Class class_name
{
Private:
    Data members 1

—
Data members n
Member functions 1
—
Member functions n
Public:
Data members 1
—
Data members n
Member functions 1
—
Member functions n
};//end of class

Class name object of Class; // creating an object of class. Private and Public are the access specifiers to the class.

STRUCTURE:

A Structure is a collection of variables of different data types referenced under one name .It also may have same data types. The access to structure variables is by default global i.e they can be accessed publicly throughout the program.
Syntax of structure.

 struct structure_name
{
   Structure variable 1;
Structure variable n; };
// end of structure

Structure_name structure object   // creating object variable of structure.

 e.g
struct student
{
   int roll;
   float marks ;
   };

Student s;

Access to structure variables
 Structure variable can be accessed by their objects only as shown below

        structure object_name. variable
e.g
        student . roll
here student is the structure and roll is the member of the structure.

UNION :
A memory location shared between two different variables of different datatypes at different times is know as Union. Defining union is similar as defining the structure.

Syntax of Union :
   union show   int i
{
       int I;
       char ch; | Byte 0 | Byte 1 |
};

char
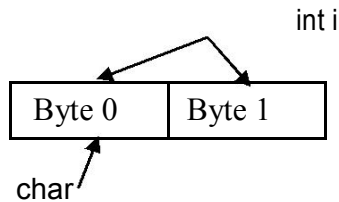
Union show obj;

References:

A reference is an alternative name for an object. A reference variable provides an alias for a previously defined variable. A reference declaration consists of base type , an & (ampersand), a reference variable name equated to a variable name .the general syntax form of declaring a reference variable is as follows.
Type & ref_variable = variable_name;
Where is type is any valid C++ datatype, ref_variable is the name of reference variable that will point to variable denoted by variable_name.

e.g   int a= 10;
        int &b= a;

then the values of **a is 10** and the value of **b is also 10;**

Constant :

The keyword const can be added to the declaration of an object to make that object constant rather than a variable. Thus the value named constant can not be altered during the program run. Syntax:-
         const type name=value;
Example:-
       const int **uage=50;** // it declares a constant named as **uage** of type integer that holds value 50.

Preprocessor Directives:

#include is the preprocessor directive used in C++ programs. This statement tells the compiler to include the specified file into the program. This line is compiled by the processor before the compilation of the program.
       e.g #include<iostream.h>
the above line include the header file *iostream* into the program for the smooth running of the program.

Compilation and Linking

Compilation refers to the processing of source code files (.c, .cc, or .cpp) and the creation of an 'object' file. This step doesn't create anything the user can actually run. Instead, the compiler merely produces the machine language instructions that correspond to the source code file that was compiled. For instance, if you compile (but don't link) three separate files, you will have three object files created as output, each with the name <filename>.o or

<filename>.obj (the extension will depend on your compiler). Each of these files contains a translation of your source code file into a machine language file -- but you can't run them yet! You need to turn them into executables your operating system can use. That's where the linker comes in.

Linking refers to the creation of a single executable file from multiple object files. In this step, it is common that the linker will complain about undefined functions (commonly, main itself). During compilation, if the compiler could not find the definition for a particular function, it would just assume that the function was defined in another file. If this isn't the case, there's no way the compiler would know -- it doesn't look at the contents of more than one file at a time. The linker, on the other hand, may look at multiple files and try to find references for the functions that weren't mentioned.

ERRORS:

There are many types of error that are encountered during the program run. following are some of them:

1. **Compiler error**.: The errors encountered during the compilation process are called Compiler error. Compiler error are of two types

- Syntax error.
- Semantic error.

   Syntax Error: Syntax error is the one which appears when we commit any grammatical mistakes. These are the common error and can be easily corrected.

   These are produced when we translate the source code from high level language to machine language.

   e.g **cot<<endl;** This line will produce a syntax error as there is a grammatical mistake in the word **cout**

   Semantic error: These errors appear when the statement written has no meaning.

   e.g **a + b =c** ; this will result a semantically error as an expression should come on the right hand side of and assignment statement.

2. **Linker Errors.** Errors appear during linking process e.g if the word **main** written as **mian** . The program will compile correctly but when link it the linking window will display errors instead of success.

3. **Run Time error:** An abnormal program termination during execution is known as Run time Error.

e.g. If we are writing a statement   X = (A + B) /C ;

   the above statement is grammatically correct and also produces correct result. But what happen if we gave value 0 to the variable c, this statement will attempt a division by 0 which will result in illegal program termination. Error will not be found until the program will be executed because of that it is termed as run time error.

3. Logical Error.: A logical error is simply an incorrect translation of either the problem statement or the algorithm.

   e.g : root1 = -b + sqrt(b * b -4*a*c) / (2 *a)

   the above statement is syntactically correct but will not produce the correct answer because the division have a higher priority than the addition, so in the above statement division is performed first, then addition is performed but in actual practice to do addition performed then divide the resultant value by (2* a).

Manipulators :

Manipulators are the operators used with the insertion operator << to modify or manipulate the way data is displayed. There are two types of manipulators **endl** and **setw.**

1. **The endl manipulator :** The endl manipulator outputs new line . It takes the compiler to end the line of display.

   cout << — *Kendriya Vidyalaya Sangathan*‖<<endl;
   cout<< — *Human Resource and Development"*;

   The output of the above code will be
   Kendriya Vidyalaya Sangathan
   Human Resource and development

2. **The Setw Manipulator** : The **setw** manipulator causes the number (or string) that follows it in the stream to be printed within a field **n** characters wide where n is the arguments to **setw (n).**

Increment and Decrement Operators in C++:

The increase operator (++) and the decrease operator (--) increase or reduce by one the value stored in a variable. They are equivalent to +=1 and to -=1, respectively. Thus:

 C++

C +=1;

C=C+1;

are all equivalent in its functionality: the three of them increase by one the value of C.

A characteristic of this operator is that it can be used both as a prefix and as a suffix. That means that it can be written either before the variable identifier (++a) or after it (a++). Although in simple expressions like a++ or ++both have exactly the same meaning, in other expressions in which the result of the increase or decrease operation is evaluated as a value in an outer expression they may have an important difference in their meaning:

In the case that the increase operator is used as a prefix (++a) the value is increased **before** the result of the expression is evaluated and therefore the increased value is considered in the outer expression;

Example 1

B=3;

A =++B;   // (here A contains 4, B contains 4).

In case that it is used as a suffix (a++) the value stored in **a** is increased **after** being evaluated and therefore the value stored before the increase operation is evaluated in the outer expression.

Example 2

B=3;

A=B++;   // (here a contains 3, B contains 4).

In Example 1, B is increased before its value is copied to A. While in Example 2, the value of B is copied to A and then B is increased.

1. What is the name of the function that should be present in all c++

program? Ans:main()

2. What are C++ comments?
Ans: comments are internal documentation of a program which helps the program for many purposes.

3. What is indentation of a program?
Ans: It is the systematic way of writing the program which makes it very clear and readable.

4. What is #include directives?
Ans :it instructs the compiler to include the contents of the file enclosed within the brackets into the source file.

5. What is role of main() in c++ program?
Ans:This is the first line that a C++ compiler executes. Program starts and end in this function.

6. What is a header file?
Ans:Header file provide the declaration and prototypes for various token in a program.

7. What is the purpose of comments and indentation?
Ans: the Main purpose of comments and indentation is to make program more readable and understandable.

8. What are console input /output functions?
Ans: Console I/O functions are cout and cin.

9. Write an appropriate statement for each of the following:
    1. Write the values for a&b in one unseperated by blanks and value of after two blanks lines.
    Ans: cout<<a<<b<<endl<<endl<<c;

    2. Read the values for a,b and c.
    Ans: cin>>a>>b>>c;

3. Write the values for a and b in one line, followed by value of c after two balnk lines.
Ans: cout<a<<b<<'\n\n'<<c;

10.What type of errors occurs while programming?
    Ans: There are three types of errors generally occur
                    are: 1.Syntax error
                    2.Semantic error
                    3.Type error.
11. How _/' operator is different from _%' operator?
Ans: _/' operator is used to find the quotient whereas % operator is used to find the remainder.
12. Which type of operator is used to compare the values of
operands? Ans: Relational operators.
13. How will you alter the order of evaluation of operator?
Ans: We can use parentheses to alter the order of evaluation of an equation.
14. What is the unary operator? Write 2 unary operator .
Ans : The operator which needs only one operand is called as unary operator .The _++'
(increment) and __ _'(decrement) operators.
15. What is output operator and input operator?
Ans: The output operator (—<<‖) is used to direct a value to standard output. The input
operator (—>>‖) is used to read a value from standard input.
16. What will be the output of following
code: void main()
{
int j=5;
cout<<++j<<j++<<j; // in cascading processing starts from right to left
}
Ans. 7 5 5

17. What will be the output of following code:
void main()
{
int j=5;
cout<<++j + j++ +j++; // values will be: 6 6 7 (From left to right)
}
Ans. 19
18. What will be the output of following
code: void main()
{
Int j=5, k;
k= a++ +a+
++a; cout<<k;
}
Ans. 18 (Because in evaluation of expression first of all prefix are evaluated, then it's value is
assigned to all occurrences of variable)

Unit-3

Stylistic Guidelines:

Writing good program is a skill. This can be developed by using the following guidelines .

1. Meaningful Names for identifiers: A programmer to give the meaningful names to each section of the program so that it can help him to identify the variable used for specific purpose. This helps him to execute the right elements during the complex run of a program.

2. Ensure clarity of expression: Expression carry out the specified action. Thus they must be clearly understood by the users. There should not be any compromise with the clarity of expression.

3. Use of comments and indentations: Comments generally are used as the internal documentation of a program . if comments are used in the program they will guide the program while debugging and checking. While indentation is the proper way of writing to avoid the confusion regarding the flow of program. These highlights nesting of groups of control statements.

4. Insert blank lines and blank spaces: Blank lines should be used to separate long, logically related blocks of code. Specifically Normally in programming the standard for the use of spaces is to follow normal English rules. This means that: Most basic symbols in C++ (e.g., —=‖, —+‖, etc.) should have at least one space before and one space after them.

5. Statements :Each statement should appear on a separate line. The opening brace following a control statement such as if or while should appear on the line after the if or while, lined up with the left of the control statement, and the closing brace should appear on its own line, lined up with the left of the control statement. As an example, see the for loop in Figure 1. The opening and closing braces for a function should be lined up in the same way. The statements within a {_____} pair are indented relative to the braces.

Characteristics of a Good Program:

Following are the characteristics of a good program.

1. Effective and efficient: The program produces correct results and is faster, taking into account the memory constraints.

2. User friendly: The program should be user friendly. the user should not be confused during the program execution . The user should get correct direction and alerts when he is going through the program.

3. Self documenting code: A good program must have self documenting code. This code will help the programmer to identify the part of the source code and clarify their meaning in the program.

4. Reliable: The good program should be able to cope up from any unexpected situations like wrong data or no data.

5. Portable: The program should be able to run on any platform, this property eases the use of program in different situations.

Stages of Program Development Process:

A program development process is the step by step process in converting the inputs into outputs.

1. Analysis: this is the important phase where all the requirements of the program are gathered and the problem is cracked downed. An algorithm is formulated which gives the solution for the problem.

2. Design : In this phase of design a Model is developed which I look a like of a program . this phase gives the face to the program. Outputs are designed in this phase.

3. Coding : In this stage the algorithm is translated into the program called source code using some programming language.

4. Compile the program: Issue a compile command against source, and fix any compile errors that arise.

5. Execute the program: An error free program after compilation is put to run to produce the output. This phase is called run-time, the phase of program execution during which program instructions are carried out.

Robustness:

Robustness is the ability of the program to bounce back an error and to continue operating within its environment.

Documentation: Documentation referrers to written descriptions specification, design code and comments , internal and external to program which makes more readable and understandable.

Uses of documentation:

1. This becomes an useful interface between a technical personnel and non technical personnel.

2. This is very useful for upkeep and maintenance.

3. Documentation makes ease for any technical emergencies.

4. Very useful in operating for learners and trainers.

5. Enables trouble shooting when the application system breaks down.

PROBLEM SOLVING METHODOLOGY AND TECHNIQUES:

To develop an efficient and effective programs we should adopt a proper problem solving methodology and use appropriate techniques. Following are some of the methods and techniques to develop a good program.

1. Understand the problem well : for a good program one should understand the problem well . one should know what exactly is expected from the problem. Knowing the problem well is the half way done.

2. Analyze the program. : analyzing the problem involves identifying the program specification and defining each program's minimum number of inputs required for output and processing components.

3. Code program : This step is the actual implementation of the program. In this program algorithm is translated into programming language. in this it is essential to decide which technique or logical will be more appropriate for coding.

4. Test and Debug program.: Once the solution algorithm is coded the next step is to test and debug the program. Testing is the process of finding errors in a program and debugging is of correcting the errors. The developed program is put to test in different conditions and verified at different level for its proper and efficient working.

****

UNIT-4

Programming in C++

Chapter -1

Investigation of Programming Construct in C++.

OBJECTIVES :

- **to emphasize the programming construct available in C++**
- **to investigate each and every programming construct emphasizing the situation where they can be used perfectly.**
- **to demonstrate few working program in C++ using the constructs.**

1.1 Why and What of Constructs in C++ programming

1.1.1 : Flow of logic

You have seen in the previous unit that a program is implementation of an algorithm (steps involved in problem solving) using a particular programming language like C , C++ , Java etc. In our case we are using C++ as a high level language (HLL) to code our programs.

A programming language like C++ is having a bundle of programming elements like tokens , identifiers , variables , constants , operator symbols , punctuation symbols etc. (please refer to earlier unit if you have not learnt all these terms.) . All these programming elements helps a programmer to write simple C++ programs as shown below :

```
program 1.1

        // a simple program in C++ to add two integers
        #include<iostream.h>
        void main( )
        {

            int a = 0 ,  b = 0 ;
            cout<<"Input two numbers";
            cin>> a>>b;
            cout<<"The sum of numbers are: " << (a+b);
        }
```

The above program is a very basic program which asks two integer values from user and prints out their sum. In the above program you may observe that various programming elements like:

     # < ( ) { = , a b << >> int void main —Input two numbers — ;
are being used.

Work out yourself :

Identify each of the above programming elements and
write its name using a table

Students the program above is very simple to be thought , written and executed, but in real industrial programming situation we seldom get such programs to write. There are many complex situation in life where we often need to write programs using few advanced programming elements. Let us investigate few of the real life situations :

   a) Ram needs to find out whether any number is divisible by both 3 and 5.

   b) A shopkeeper wants to give x % discount on a particular purchase only when the net purchase by his customer exceeds Rs. 1000

   c) A teacher wants to calculate the average marks for each of his 40 pupils in a class.

   d) Suresh wants to continue his program till he is pressing escape button on keyboard.

Can you program the above programming problems using the programming elements of C++ which you have learn till now ?

Your answer would be probably a NO , because the C++ programming elements which you have studied till now , will only enable you to write **simple linear programs , or sequential programs**.

1.1.2: *Linear Flow*

A simple linear program is one which has a linear flow of execution of programming logic /statements. e.g. program 1.1. The logic of program flows (or better they are termed as control flow) from top to bottom out of set of statements.

Now let us proof the that program 1.1 follows a sequential flow of logic by the following flow chart diagram :
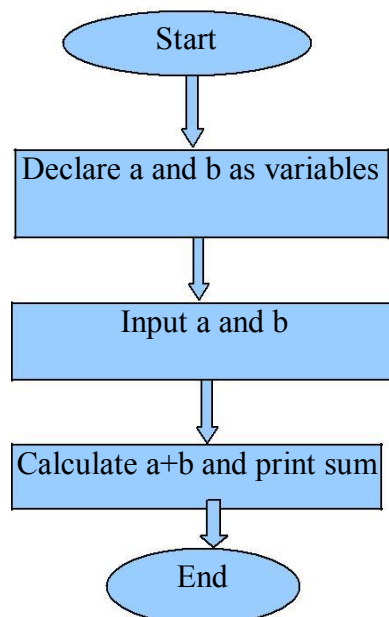
flowchart : 1

So easy isn't it ? As you observe that the arrows are moving in one direction only from top to bottom , the flow of program is sequential / linear.

Work out yourself :

> Identify few of the programs which you have written while dealing
> Unit-3 and find whether they are following sequential flow of
> program? If yes can you make a flow chart to justify your idea.

So there exist a big question now that whether C++ programs have other types of flow of program which is totally different from linear flow. Yes , students we also have other types of flow of program.

Conditional Flow

Let us investigate the real life problems visited by us earlier in this chapter :

   a) Ram needs to find out whether a number is divisible by both 3 and 5

We will represent the above problem in flow chart notation :
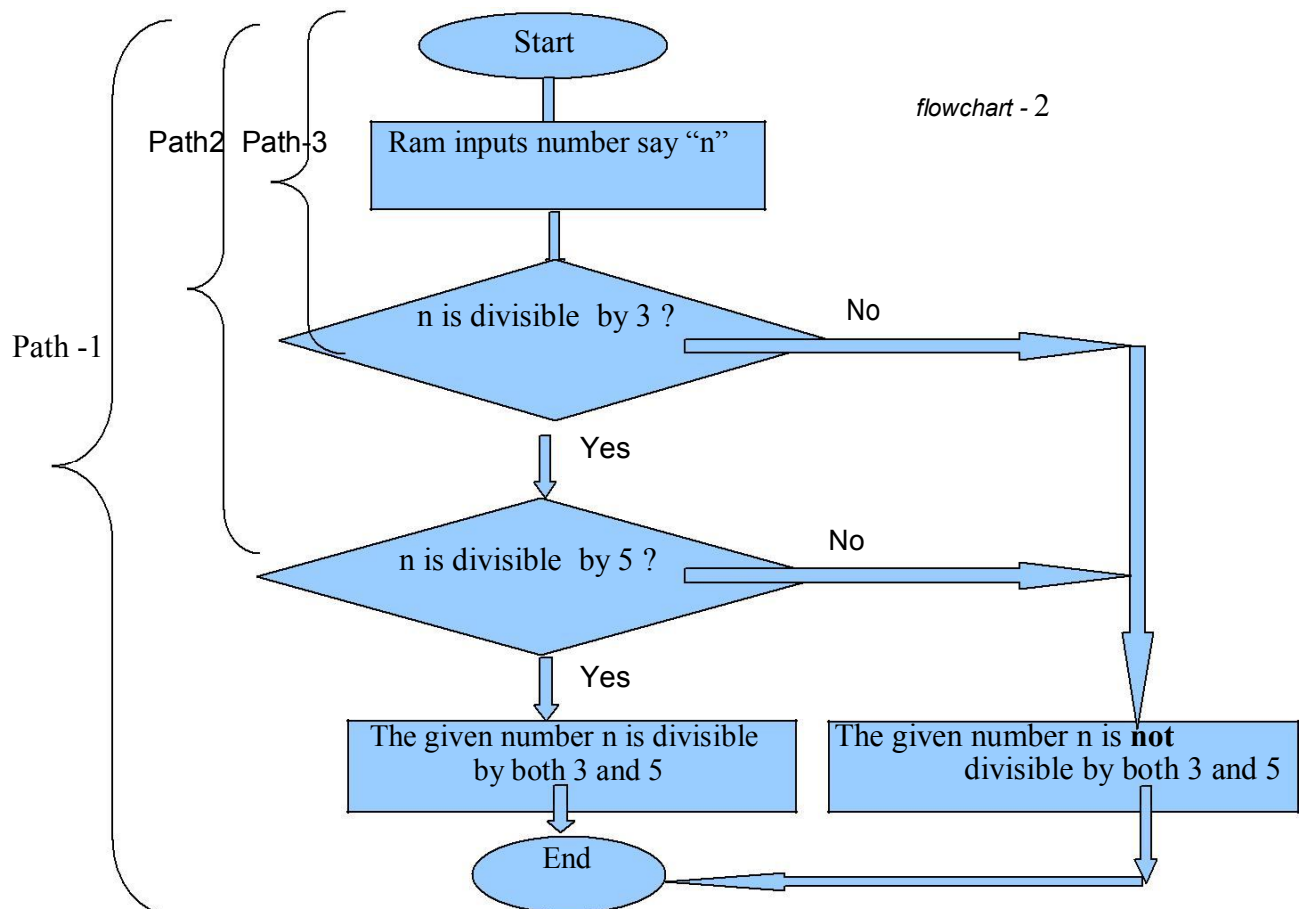
flowchart - 2

Observe the above flowchart-2 and compare it with the earlier flowchart – 1 and then answer the following questions :

     i) Are arrows in the flowchart (which represent flow) emerging and proceeding in one direction in both flowcharts ? [Yes / No].

     ii) If answer to the first question is No then why not ?

     iii) Let us call the flow of arrows in a particular direction a **Path** then how many such paths you observe in first flowchart and that in second one ?

     iv) In flowchart – 2 we have used rhombus. What is its significance in whole flowchart?

So going through the questions above and answering them yourself you find that in the second flowchart is different from the first one in following respect :

    1)   The direction of arrows in second flowchart is not always linear, sometime the direction of the flow takes turns at the junction of a rhombus. (there are two such such turnings)

    2)   At each rhombus junction the flow decides which way to proceed after asking a logical statement (e.g n is divisible by 3) , thus creating several paths following which the program logic can flow. In our flowchart -1 there is no such branching of paths is observed, but in case of flowchart-2 we may observe two branching where from a program can flow through to reach end and terminate itself.

So we may now emphasize that a program not only have a linear flow but it can also have a branched flow as observed in flowchart- 2. Each of these branches can be interpreted as one execution path of the same program. Hence we can say that in real world, there exist some programming situation which needs branched flow of program instructions, or in simple terms we may say that the program demands several paths of execution.

Thus,

> **A program having multiple paths of execution, where each path leads to different type of completion states, are categorized as Conditional Programs.** The selection of paths of execution depends upon a logical decision being made (look at the rhombuses)

When we consider our problem then it is seen that a number when it is satisfying both the logical conditions at two rhombuses ends up with a result that it is divisible by both values 3 and 5(execution path -1) whereas if it not satisfying either of the two logical conditions placed at two rhombuses then the program ends up with another result showing it is not divisible by both of them together. Satisfying any one of the logical condition would not solve our purpose as we are expecting a logical AND (&&).

Now let us convert the above flowchart -2 in a C++ program. You may not understand all the parts of programs here, so don't worry it will be described in the later part of the chapter.

Program – 1.2

   // program to implement the problem described by flowchart-2

   ```
   #include<iostream.h>
   void main( )
   {
           int num = 0 ;   // declaring a variable num

           cout<<‖Input the number you want to check‖
           ; cin>>num; // Inputting value of n
   ```



   ```
   }
   ```

 The shaded part of the above program shows how a conditional branching is implemented with an if ( )- else construct of C++.

Workout yourself :

 Draw flowcharts for problem situation b) given earlier in page no. 4, and then find whether the problem follows a linear flow or conditional flow ? Check it out with you teacher.

1.1.3 : Iterative Flow / Cyclic Flow :

Now let us solve the problem situation c) given in page 4 with the help of a flowchart . i.e

A teacher wants to calculate the average marks for each of his 40 pupils in a class.

Let us assume that the teacher maintains count of his/her students in a variable say
n. Let the teacher starts n from 1st student i.e n = 1
Let there are marks in five subjects say s1 , s2 , s3 , s4 and s5 and Avg as Average

We must remember that this problem demands calculation of average marks of each student,
i.e Average marks for each of the individual 40 students would be calculated and displayed.

Flowchart - 3

Start

Declare & Initialize n = 1 and
s1=s2=s3=s4=s5 = 0

Whether n <=
40 ?

No

End

Yes

Input the value of s1 , s2 , s3 , s4 , s5
for student number n

Calculate Avg = (s1 + s2+s3+s4+s5)/5 for student number n

Print the value of Avg for   student number n

Increase the value of n by 1
So that n proceeds to next student

Observe the above flowchart-3 and compare it with flowchart-2 given earlier. Try to answer the following question :

a) Are directions of arrows in both flowchart 2 and 3 are always pointing downwards ? **[Yes / No]**

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b) If your answer to the above question a) is in No then what are other directions in which arrows proceeds? **[choose from : Leftwards , Rightwards , Upwards , all of them]**
c) In which flowchart the arrow proceeded upwards and Why ?

Verify your answer with your teacher.

Sometime according to special problem situation we find that in a program we proceed to a same statement / step again , which we have visited earlier during flow of program. Observing flowchart – 2 we find that we never proceed to a step twice.

In case of flowchart-3 we observe that steps after the rhombus are repeated if logic in rhombus produces a Yes value (you may see that an arrow moves upwards to the rhombus). **A cycle is formed between the Rhombus and steps after it, based on the Yes value of the logic (n <= 40 ?) kept in rhombus.**

This cyclic path of execution is referred as an **Iteration** in C++ programming jargon.

Workout yourself :

i) How many times the program proceeds in a Cyclic path in the flowchart- 3. Why ? When does this cyclic path of execution ends in the flowchart-3.

ii) What will happen if the cyclic path of execution never gets ended?

The cyclic path of execution or Iteration in problem represented by flowchart-3 ends **based on the No value of the logic (n <= 40 ?) kept in rhombus.** This **No** will be generated when n will become anything greater than 40.

Now let us convert the above flowchart -3 in a C++ program. You may not understand all the parts of programs here, so don't worry it will be described in the later part of the chapter.

Program – 1.3

> *// program to implement the problem described by flowchart-2*

```
#include<iostream.h>
void main( )
{
        int n = 1 ;                 // declaring a variable n to keep count of students
        int s1 = s2=s3=s4=s5=0;     // declaring subject marks and initializing them with 0
        float Avg = 0.0 ;           // declaring variable for keeping Average of student's
marks

        cout<<‖Input the number you want to check‖
        ; cin>>num; // Inputting value of n
```

```
        }
```

 The shaded part of the above program shows how an Iteration is implemented with a **while( )** construct of C++. A while( ) construct instructs the compiler to repeat the set of statement under its scope { } if the logical expression (here : n <= 40) attached with it produces a True value. If the logical statement fails to produce a True value (i.e. when n becomes 41) then the iteration is ended just by terminating the scope of while( ) construct and thereby terminating the program.

The Iterative flow of program is also called as Looping , in above program we have used a while( ) loop construct.

Let us summarize what we have learned till now :

Workout yourself :

Draw flowcharts for problem situation d) given earlier in page no. 4, and then find whether the problem follows a linear flow or conditional flow ? Check it out with you teacher.
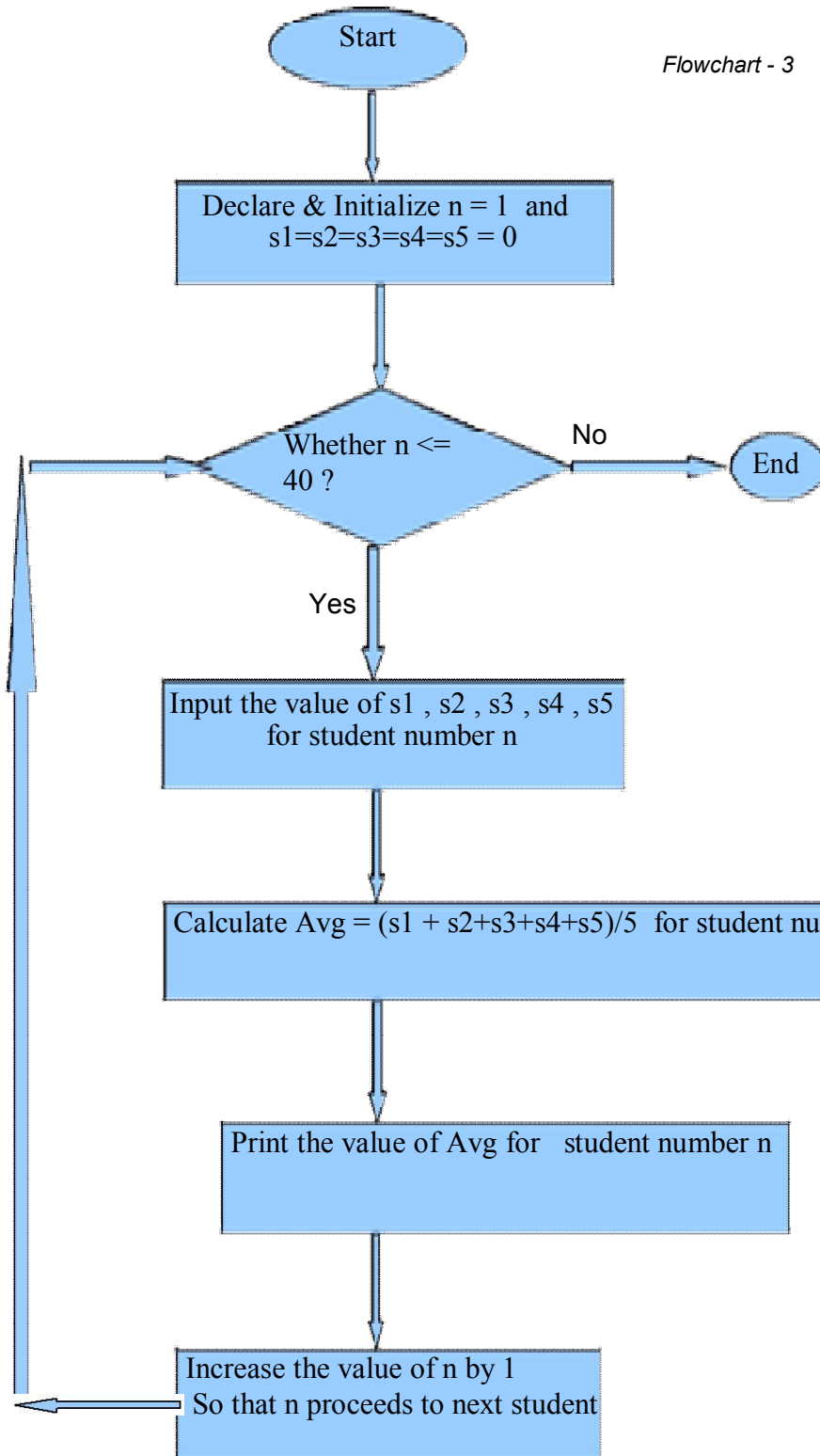
Check your progress:

Here are few programming situations given to you find categorize each of them according to the type of flow of control they require , i.e. Sequential , Conditional or Iterative by writing S , C and I before them :

1. Dinesh wants to find simple interest on a given amount at a particular rate of interest for fixed number of years.

2. Adarsh wants to compute compound interest on a given principal , rate and time but without using compound interest formula taught to him in class VIII.

3. Mahalaxmi wants to check whether her weight is an odd number or even.

4. Surekha wants to calculate area of a triangle using Heron's formula.

5. Ravi while designing a game program , wants that his game character kicks his motocycle 5 times before the motorcycle gets started.

6. Ayush wants to calculate factorial of a number if the number is even otherwise he wants to find its reciprocal.

7. Mera Bank wants that its customer will be able to draw money from there account only when there is a minimum balance of Rs. 1000 left in their account after the withdrawal.

Check and discuss your answers with your teacher.

Chapter -2

Using C++ constructs

Objectives:

- **to analyze syntaxes of various programming constructs available in C++.**
- **to draw comparison between various programming constructs.**
- **to apply the syntax of various programming constructs in problem solving**

2.1 Categories of available constructs

After exploring into various types of flow of control / logic in different programming situations let us go through the detailed syntax/format of each of the programming constructs available in C++, using which we can monitor flow of control in our program. Here is one diagram which categorizes C++ constructs in detail :

```
                    Programming Constructs


    Sequential          Conditional              Iterative

  Simple programs     – if ( )      (Simple if )    – for( ) loop ( Entry control)
   using identifiers,
   operators, expressions  – if( ) - else (Compound if )  – while( ) loop (Exit control)
   etc.
                       – if-else-if( ) (complex if / Ladder  – do – while( )  (Exit control)
  -does not requires                          if else)
   branching or repetition  – Nested if( )
   of statements
                       – switch( )- case statement

                       – Conditional Operator ( ?  : )
```

Let us deal each one of them one after another in detail.

2.1 Conditional Constructs :

2.1.1 : Simple If ( )

points to remember :

      i) a logical statement always evaluates as true / false.

      ii) any value in C++ other than zero (positive / negative) is considered to be true whereas a zero (0) is considered to be false.

      iii) < > in syntax is known as a place holder, do not type it while writing program. It only signifies that any thing being kept there varies from program to program.

      iv) if there exists only one line of program statement under if( ) scope then we may ommit curly braces { }

The statement kept under simple if ( ) gets executed only when the conditional expression/logical statement under it is evaluated as true.

Examples :

In the above example the conditional statement under if ( ) will be always evaluated as true because the value of x will become 4 before the comparison thus the expression 4 > 3 yields a true value letting the statement under if( ) to execute i.e. the output of the above code snippet would be
— x is greater ‖

Workout yourself :

Convert the above code snippet into a program in your practical period and execute it, verify the output.
 Now change the initial value of x to 0 instead of 1 i.e. Change x = 0 in the program. Execute the

2.1.2 : Compound If ( ) : if – else combination

syntax :

Example :

The above code snippet (portion) has two different paths of execution. If the conditional statement under if( ) is evaluated to be true then the statement under if ( ) block will be executed otherwise the statements under else block would be executed. The above code produces an output as ―we are in else part because x and y both became equal.‖ because the conditional statement under if ( ) evaluates as false as x is not greater than y, it is same as that of y.

Workout yourself :

In the above code snippet modify the logical statement under if ( ) such that the if ( ) block gets executed instead of else( ) block. You should not modify the initial values of x and y or change number of variables in the program.

2.1.3 : Complex If ( ) : if – else ladder

syntax :

```
        // do something if condition -2 is satisfied
}
else if (<condition – 3 >)
{
        // do something if condition- 3 is satisfied
}
                :
                :    // many more n-1 else - if ladder may come
                :
else if( < condition – n >)
{
        // do something if condition – n is satisfied
}
else
{
        // at last do here something when none of the above else-if( )
        //conditions gets satisfied.
}
```

In the above syntax there are ladder of multiple conditions presented by each if( ) , all of these conditions are mutually exclusive that is only one of them would get satisfied and all the conditions below it would not be evaluated and is discarded.

Say suppose if condition-3 gets satisfy i.e. it yields a true value for the condition, the statement under the block of third if( ) gets executed and all other n number of if( ) conditions below it would be discarded.

If none of the n if ( ) conditions gets satisfied then the last else part always gets executed. It is not compulsory to add an else at the last of the ladder.

Example :

In above code snippet a character is being inputted from user and is being checked upon by various if ( ) condition as alphabets, digit or any other special symbol. If the first condition gets satisfied then the character inputted is a lower case alphabet, if not then the second if ( ) is evaluated , if the second if( ) gets satisfied then the character is an upper case alphabet, if not then the third if ( ) is being evaluated , if it is satisfied then the character is a digit if not then finally it is inferred as any other symbol in the last else( ) .

The benefit of this type of conditioning statement is that we can have multiple conditions instead of just having one or two as seen in case of earlier if( ) constructs.

Workout yourself :

A date in the format of dd/mm/yyyy when dd, mm, and yyyy are inputted separately is said to be a valid date if it is found in a particular year's calendar. For example 22/12/2012, 29/02/2012 are valid dates in calendar of 2012, but 31/06/2012 or 30/02/2012 are invalid dates in calendar of 2012.

Find out how many ladders of if( ) conditions would be required to write a program for checking validity of a date.

Discuss your answer with your teacher.

2.1.4 : Nested if-else

You might have seen a crow's nest or any other bird's nest , the materials being used to build the nest are enclosed within one another to give ample support to the nest.

We also have the same concept of nesting of constructs within one another , to give ample strength to our program in terms of robustness , flexibility and adaptability (these terms you have learned in Unit - 3 earlier.)

We are now considering nesting of an if ( ) construct within another if ( ) construct i.e one if( ) is enclosed within the scope of another if( ). The construct thus formed is called nested if( ). Let me show you few of the syntax forms of nested if( ) :

Syntaxes: **Simple if ( ) nested within scope of another simple if ( )**

//some statements to be executed
// on satisfaction of outer if ( ) condition.

} // end of the scope of outer if( )

compound if ( ) nested within scope of another compound if ( )
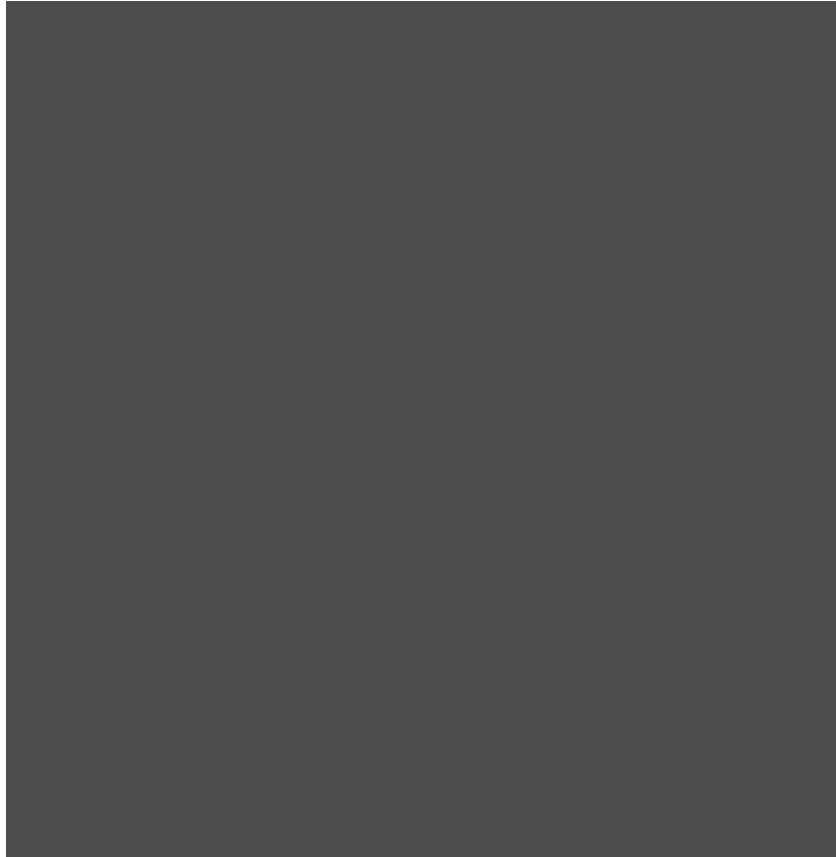
Ladder if-else-if ( ) nested within scope of another ladder if-else-if ( )

```
                        //some statements to be executed
                        // on satisfaction of outer  if ( ) condition.

                }
                else if ( <outer-condition-2 >)
                {

                        // statements on failure of outer if( )
                }
```

Like this you may try to keep any type if( ) construct within the scope of other type of if ( ) construct as desired by the flow of logic of that program.

Workout yourself:

I) Try to nest simple if ( ) upto 4 levels ii) Try to nest complex if within a compound if ( ) iii) Try to nest three simple if ( ) within another simple if( )

let us now explore few example programs using various if( ) constructs :

program 2.1

// program to compare three integer values to find highest out of them

```
#include<iostream.h>
void main( )
{
        int n1= n2 = n3 = 0;
        cout<<‖Input three integers‖;
```



```
}
```

Explanation :

Lets parse the logic of the above code (shaded area) to understand it using a dry run :

Case – I

let us assume that the value of **n1 = 1 , n2 = 5 and n3 = -7**

evaluation of the first if( ) in the ladder :

```
                    if( n1 > n2 && n1 > n3 )
                    ==> if( 1 > 5 && 1 > -7 )
                    ==> if ( false && true )
                    ==> if( false )  // as per truth table of logical and ( && ) operator
```

since the first condition is evaluated as false so the next condition in the ladder would be evaluated

```
                    if( n2 > n1 && n2 > n3 )
                    ==> if ( 5 > 1 && 5 > -7 )
                    ==> if ( true && true )
                    ==> if(true) // as per truth table of logical and ( && ) operator
```

since the second logic is evaluated as true, it open the block of second if( ) and the statements under the second else-if ( ) block gets executed and an output is printed on the console as :
      ―5 is highest value‖

Workout yourself :

I) Try to execute the above program 2.1 using dry run method with values n1 = 1 , n2 = 1 and n3 = 1

ii) Try to implement the above program using any other type of if( ) construct

program 2.2

// program to find whether a 4 digit inputted year is a leap year

```
#include<iostream.h>
void main( )
{
        int year = 0 ;
        cout<<‖Input a 4 digit
        year‖ cin>> year;
```

```
          {
                    cout<<‖Year : —<< year << — is not a leap year‖;
          }


     } // end of main ( )
```

The above program is a very good example showing the use of nesting of if( ).

Explanation:
     Let us first understand which year would be called leap year , a leap is a year which :

     i) is divisible by 4 but not divisible by 100
     ii) is divisible by 4 as well as divisible by 100 and at the same time divisible by 400

 Any other criteria will make the year as a non-leap year candidate.

Dry Run -1

Let us parse the gray area code of the above program with a dry run having year = 1994
     if(1994 % 4 == 0)
     ==> if (2 == 0)
     ==> if (false)
 Since the first if condition is not satisfied the flow of the program proceeds to its else block and prints the output as — Year : 1994 is not a leap year‖

Dry Run – 2 :

 Let us parse the gray area code of the above program with a dry run having year = 2000

     if(2000 % 4 ==
     0) ==> if (0 == 0
) ==> if (true)

Since the first condition evaluates out to be true it opens up its block and the next statement in the inner block gets executed as :

               ==> if (2000 % 100 ==
               0) ==> if (0 == 0)
               ==> if (true)
Since the first nested if ( ) condition evaluates out to be true it opens up its block and the next statement in the inner block is continues as :

               ==> if(2000 % 400 ==
               0) ==> if (0 == 0)
               ==> if (true)
Since the second nested if ( ) condition evaluates out to be true it opens up its block and the next statement in the inner block is continues to print output on console as :

     —Year : 2000 is a leap year‖

Workout yourself:

i) Google out to find that whether year 1900 was a leap year or not and then verify it using a dry run with the help of above program.
ii) Try to implement the above code without using nested if ( ) construct.

Check your progress:

1. Find error in code below and explain. #include<iostream.h>

```
void main()

{

        int x = 5 ;

        if( x > 5 )

        {

          x += 5;

          int y = 8;

        }

        y += x;

}
```

2. Find the output of the code below :

```
void main( )
{
        int NoOfGirls = 4; int
        NoOfBoys = 10 ;

        if ( NoOfBoys = 8 && NoOfGirls <= NoOfBoys )
                cout<<‖Great achievement‖;
        else
                cout<<‖Greater achievement‖;
}
```

3. Find the output of the code below :

```
void main( )
{
        int circle = 5 , rectangle = 0 , square = 4 , triangle = 0
        ; if( circle)
        {
```

```
                    if( rectangle || square )
                    {
                            cout<<"Draw diagram";
                    }
                    else if( ! rectangle  && ! square )
                    {
                            cout<<"Invalid diagram";
                    }
                    else
                    {
                            if( circle == rectangle || square == triangle )
                            {
                                cout<<"Canvas Available";
                            }
                    }
            }
            cout<<"Invisible diagram";
    }
```

4.   Find the output of code below:

```
    void main( )
    {
            int x = 3 , y =
            5; if( x <= 5 );
              cout<<"Hurray";
            else
              cout<<" Trapped";
    }
```

5.   Write a program which inputs day(dd) , month(mm) and year(yyyy) and checks whether it is a valid date or not. [A valid date must lie on the calendar]

6.   Dipu Jwellers gives discount on a fixed purchase total based on following criteria :

Offer	Offer Months	Discount %	Purchase total
Winter Bonanza	Oct to Feb	30	Between 3000 to 5000
Summer Bonanza	Mar to June	20	Between 10000 to 12000
Monsoon Bonanza	July to Sep	10	Between 2000 to 10000

If the purchase amount of a customer does not lies between the given purchase total then no discount should be given.

Write a program to calculate the Bill amount of a purchase after giving proper discount.

2.1.5: switch-case statement

switch-case construct is a type of conditional construct which resembles the same flow of logic as that of ladder if-else-if with few exceptions. Let us observe the syntax of the switch-case construct of C++ :

Syntax :

```
switch ( <switching variable | switch expression >)
{
```

A switch-case control matches a particular switching value in a switch variable or a value generated after evaluating an expression with several values, when it finds an exact match between switch variable value and case value it enters into that particular case to execute the statements under that case, and then on finding a break statement it jumps out of the case and then comes out of the scope of switch-case without considering other cases value.

Example:

```
int menu_choice = 0;
cin>>menu_choice ;
switch (menu_choice)
{
```

```
                    case  1 :
                        cout<< —press key 's' to start the
                        game‖; break;
                    case  2 :
                        cout<<‖press key 'n' to navigate through game
                        plan‖; break;
                    case 3 :
                        cout<<‖press key 'c' to change the level of the
                        game‖; break;
                    case 4 :
                        cout<<‖press key 'f' to fast your
                        speed‖; break;
                    case 5 :
                        cout<<‖press key 'x' to exit from
                        game‖; break;
                    default :
                        cout<<‖you have to choose between 1 to 5‖ ;
            }
```

The above code implements a game menu design where inputted integer value in the switching variable menu_choice is being matched with values 1 to 5 , each value representing one game action.

You may observe that the flow of the switch-case construct is same as ladder if-else-if construct, because it also deals with multiple paths of execution out of which a selected path gets executed. If none of the conditions gets satisfied then the statements under the default case gets executed.

Points to remember while using a switch-case construct in a program :

a) a **break statement** always ends a case, if break is not placed then all the cases after the current case gets executed till a break statement is met.

b) a switch-case always matches its switch variable value with a single constant case value, this case value must always be a single integer value or a single character. Floats and double values of switch variable are not valid. i.e. the code below is invalid code :

```
        float v = 0.0        ◄─────── Invalid switch variable declaration
        cin>> v;
        switch( v)
        {
            case 1.1 :     ◄───── Invalid case value
                // do something
                break;
                …
        }
```

c) the cases in the switch cannot provide a range of values to be matched with the

switching variable i.e. we can't write statements like >= 4 && <= 9 with cases. The following code is invalid :

```
char ch = '*' ;
cin >> ch;
switch(ch)
{
        case >='a' && <='z'

                cout<<‖You have entered lowercase
                alphabet‖; break;
        case >= 'A' && <= 'Z'
                cout<<‖You have entered uppercase
                alphabet‖; break;
}
```

The above code gives us an example where ladder if-else-if has an advantage or switch-case, because we can have a logical statement having a range of values to be compared.

 d) The sequence of case value does not matters i.e. It is not compulsory to keep a lower case value as first case and the highest case value being the last case. They can exist in any order.

 e) The default case is optional and should be always kept at the last place in switch-case construct
 f) A switch-case construct can also be nested within another switch-case operator.

Workout yourself :

i) Write a program which inputs a month number from user and then finds the total days present in that month. Use only switch-case construct. For example if user inputs month number as 2 then the program displays —February has 28 or 29 days‖.

ii) Compare and contrast switch-case construct with ladder if-else-if construct in a tabular form.

2.1.6 : Conditional operator (< > ? <> : <>)

Conditional Operator is a small short hand operator in C++ which helps to implement flow of logic based on some condition like if-else construct. The syntax of the conditional operator is :

Syntax :

 The logical expression in the operator gets evaluated either as true or false , if true then statement after symbol (?) gets executed otherwise statement after symbol (:) gets executed. It acts much like an if ( ) - else construct but can only execute single statement. Like if-else the conditional operator

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cannot have a block of code to execute in its true or false part.

We often use conditional operator to implement a short one line conditional expression.

Example:
```
int x = 5 , y = 7;
int result = ( x > y ) ? 1 : 0;
cout<< result;
```

The output of the above example would be 0 because the condition x > y is not being satisfied , hence the value 0 is being assigned to result. A conditional operator can be also nested within another conditional operator.

Workout yourself:

Write a program using conditional operator to find the highest of three inputted integers. [Hint : use nesting of conditional operator]

2.1.7 : Nesting of all conditional constructs

In real life programming situations often all the conditional constructs are being used in a single program. Any of the conditional construct can be nested within any of the other construct. For example a switch-case construct can nest a ladder if-else-if within its scope, or each ladder condition of a ladder if-else-if may nest a switch-case construct within its scope. The following code snippet justifies this idea :

```
                          else
                          {
                              // some code
                          }
                      break;
                          …
          } // end of switch-case
```

Similarly we can have :

Ask your teacher which of the constructs can be nested within which of the other constructs.

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Check Your Progress :

1. Find the output of the code given below
   ```
   : #include<iostream.h>
   void main( )
   {
           int x = 3;
           switch(x)
           {
                   case 1 : cout<<
                     —One‖;
                     break;
                   case 2 : cout<<
                     —Two‖;
                     break;
                   case 3 :
                     cout<<
                   —Three‖ case 4 :
                     cout<<
                   —Four‖; case 5:
                     cout<< —Five‖;
                      break;
           }
   }
   ```

2. Find error in following code :

   ```
   #include<isotream.h>
   void main()
   {
     int a = 10;
     int b = 10;
     int c = 20;

    switch ( a ) {
           case b:
                   cout<<‖Hurray
                   B‖; break;
           case c:
                   cout<<‖Hurray
                   C‖; break;
           default:
                   cout<<‖Wrong
                   code‖; break;
     }
   }
   ```

2.2 Iterative Constructs (Looping):

Iterative constructs or Loops enables a program with a cyclic flow of logic. Each statement which is written under the scope of a looping statement gets executed the number of times the iteration/looping

continues for.

In previous chapter we have seen few real life scenarios where a looping construct is needed for performing a particular set of tasks repeatedly for a number of times. Now we will go into details of all looping constructs available in C++.

In C++ there are three basic types of looping constructs available, they are :

- while( ) loop   // keyword while is used to loop

- do-while( ) loop   // keywords do and while are used to loop

- for loop   // keyword for is used to loop

It is very important to understand that a looping construct enables repetition of tasks under its scope based on a particular condition called as **loop-condition**. This loop-condition evaluates as true or false. A loop may be continued till a loop-condition is evaluated as true or false, based on a particular program situation.

All the above mentioned three loops have three parts common in them i.e.
- the looping variable (iterator)
- the loop-condition
- logic to change the value of iterator with each cycle/iteration

Let me show you distinguishably these three parts and then we will proceed to the syntax.

Iterator   loop-condition   logic to modify iterator value

for(int i = 0   ;   i <= 7   ;   i = i * 4   ) // *some code*

 Similarly , while and do-while also have these three significant parts as shown below :

2.2.1 : while( ) loop construct

A while loop tests for its ending condition before performing its contents - even the first time. So if the ending condition is met when the while loop begins, the lines of instructions it contains will *never* be carried out.

Syntax :

```
                        {
                        ...;
                        ...;
                        }
```

A while continues iteration-cycle till its loop condition is evaluated as false. If the loop-condition is false for the first time iteration then loop will not execute even once.

Example :

The above code snippet finds the sum of n natural number using while loop. The loop is executed till the x is greater than 0 , as soon x becomes 0 the loop is terminated. We observe that within the scope of the loop the value of x is decremented so that it approaches to its next previous value. Thus with each iteration the value of x is added to a variable sum and is decremented by 1.

Lets understand the above program with a Dry Run. Let us assume that user inputs a value 4 for x then at :

        1st Iteration start

                x is 4 , sum = 0 i.e. the loop-condition 4 > 0 is evaluated as true hence it opens up the while block
                ==> sum = 0 + 4 = 4
                x will be decremented by 1 , thus x = 3

        2nd Iteration start
                x is 3 , sum = 4 i.e. the loop-condition 3 > 0 is evaluated as true hence it opens up the while block
                ==> sum = 4 + 3 = 7
                x will be decremented by 1 , thus x = 2

        3rd Iteration start
                 x is 2 , sum = 7 i.e. the loop-condition 2 > 0 is evaluated as true hence it opens up the while block
                ==> sum = 7 + 2 = 9
                x will be decremented by 1 , thus x = 1

        4th Iteration start
                 x is 1 , sum = 9 i.e. the loop-condition 1 > 0 is evaluated as true hence it opens up the while block
                ==> sum = 9 + 1 = 10
                x will be decremented by 1 , thus x = 0
        5th Iteration start

x is 0 , sum = 10 i.e. the loop-condition 0 > 0 is evaluated as **false** because 0 == 0 hence it locks up the while block and while() loop is terminated.

Thus coming out of while loop block the value of sum is printed as 10 loop executes for 4 times.

Workout yourself :

Consider the program given below :

```
void  main( )
{
    int x = 5, m = 1 , p = 0;
    while( p <= 50 )
     {
          p = x * m ;
          m++;
     }
}
```

Now complete the following Iteration tracking table with details of each iteration, the first one is done for you :

Iteration	loop-condition	x	p	m
1st Iteration	0<= 50 ==> true	5	5	2

Check it out with your teacher.

Why my while loop is not getting executed ?

It is very important to understand here that in while loop the looping condition is evaluated at the beginning of the loop's scope i.e. prior to the entering into scope of loop. This type of checking is called **"Entry Control Checking"**, if the condition fails this checking it will not be allowed into the scope of the loop. That is why while( ) loops are often called as **"Entry Control Loop".** You can imagine a similar checking situation that your tickets are being checked prior to your entry into a cinema hall to view a film. You will not be able to view the film at all if you don't have the tickets !!

Similarly if the loop-condition fails at the first time itself the statements under the scope of loop will not run even once. Observe such a code scenario below :

```
noOfPersons = 4;
noOfTickets = 3 ;
```

```
        while( noOfTickets >= noOfPersons )
        {
                cout<<‖Welcome to Gangs of C++ pure‖
        }
```
 The above loop will not execute at all because the loop-condition is failing at first time.

2.2.2 : do-while( ) loop construct

A do-while loop is identical to a while loop in every sense except that it is *guaranteed* to perform the instructions inside once before testing for the ending condition.

Syntax:

Example: Consider the following code snippet to find factorial of a given number n :

```
int f = 1;
int n = 0;
cin>> n;
```


 Lets us analyze the execution of the above program : the factorial of any number n is evaluated as fact = n * (n-1) * (n-2) * ….. * 1

This means that with each iteration the value of n is decremented by 1 and is multiplied with the previous value of n is stored cumulatively. The iteration-cycle stops when n is decremented upto a value equal to 1.

Let us conduct a Dry run on the above code snippet to understand the flow of logic for **n = 4**:

Initially
        f =1, n = 4

1st Iteration-cycle:
        f = 1 * 4 = 4 , n = 3, condition n > 0 evaluates as true hence loop is continued
2nd Iteration-cycle :
        f = 4 * 3 = 12 , n = 2 , condition n > 0 evaluates as true hence loop is continued
3rd Iteration-cycle :
        f = 12 * 2 = 24 , n = 1 , condition n > 0 evaluates as true hence loop is
continued 4th Iteration-cycle :

f = 24 * 1 = 24 , n = 0 , condition n > 0 evaluates as false , as 0 == 0 hence loop is terminated and program flow comes out of the scope of the loop into program scope.

The output is printed on console as:
"The factorial of : 0 is 24"

Workout yourself :

Though the above factorial code snippet has executed nicely and produced correct and valid result of factorial of 4 i.e. 24 but while prompting output to user it wrongly says that ―factorial of :0 is 24‖ . It must show that ―factorial of 4 is 24‖.

Find out the reason for the above misprinting and correct the program by modifying the code so that it produces expected output prompt to user.

Check your result with your teacher.

Why my do-while() loop is getting executed once even when the condition is not satisfied !

It is very important to understand here that in do-while loop the looping condition is evaluated at the end of the loop's scope i.e. after the last statement in the scope of loop. This type of checking is called **"Exit Control Checking"**, if the condition fails this checking it will not be allowed into the scope of the loop on next iteration-cycle. In the whole affair you are observing that the loop had executed at least once even when condition fails in 1st Iteration-cycle. That is why do-while( ) loops are often called as **"Exit Control Loop".** You can imagine a similar checking situation that your shopping bag items and purchase bill are being checked on your exit out of a shopping mall where you have been for shopping.
For example consider the program 2.3 ahead.

Sentinels :
Often a looping construct executes loop for a fixed number of times based on certain looping condition placed on the looping variable or the iterator, but sometimes the termination of loop is not fixed i.e. the termination of loop depends on some outside input. These types of loops where termination of loop is not fixed and depends on outside input are called **sentinels.**
For example : Consider the program given below :

program 2.3

```
//  program to count number of adults and minors

#include<iostream.h>
void main( )
{
        int ad = 0 , m = 0;

        int age = 0;
```

```
        while(age > 0)
        {
            if( age >= 18 )
                ad++ ;
            else
                m++;
            cout<< —Input age
            :‖; cin>> age;
        }

        cout<< —There are total — << ad <<‖ adults and‖ << m << —minors‖;
    }
```

Can you tell how many times the loop in above question runs ? Your answer would be probably —No‖ , or better you will tell that since the termination of the loop depends upon the value of the variable age, it is not fixed that how many times the loop may run.

Yes this is the feature a sentinel has , here the value of variable age controls the execution cycle of the while () loop. If the value of the age inputted by the used before the start of the loop is inputted as 0 then the loop will not be executed at all because the condition fails on the start of the first cycle itself. Moreover it also not fixed that after how many cycles the user may input a 0 value to stop the loop , he/she may input after 3 cycles or 5 or may be 200 !

Workout yourself:

> In the above program 2.3, remove the two shaded input line placed before the start of while () construct, and then execute the code to find whether you are getting same result as before or anything wrong. If incorrect result is produced then find the reason explain it to class friends.

2.2.3 : for(; ;) loop

A for loop has all of its three parts i,e the iterator variable , loop-condition and logic to continue loop kept intact at one place separated by semi colon (;) . This loop is also an **Entry Control Loop,** as condition is checked before entering into the scope of the loop. Let us analyze the syntax of a for looping:

Syntax:

```
                                    
    {
        // do something
        …
    }
```

The first part of a for loop is a place where all looping variables are declared and initialized in the same way we declare multiple variables of a single data type : e.g. int i = 0 , j = 2 , k = 9 … ;

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This part of the loop is executed only once at the start up of the loop and never it is executed again (how can you re-declare variables with the same name! in same scope). As per turbo c++ compiler the scope of all these variables declared in for loop is same as program-scope i.e. they can be accessed from any other scope in the main( ), but the current ISO C++ has changed this making the scope of all these variable local to for loop only. You will follow the turbo c++ type scoping.

The second part of a for loop defines the looping condition using set of relational and logical operators and governs the number of times the loop would execute. This looping condition is checked before entering into loop, for e.g. i <= j+k etc.

The third part of the for loop defines how to change the value of iterative / looping variables with each cycle. This is very important as to execute the loop for a fixed number of times , for e.g. i++ , j = j+k etc

Let us now integrate all the above three parts to observe how a for loop works :

Example :

The above loop starts with declaring variable i = 0 , then it proceeds to the looping-condition part to check whether condition is satisfied (evaluates as true) so that the flow could enter into the scope of the loop. i.e. 0 <= 3 which is true , the control flow is allowed to enter into the scope of the loop and all the statements (the 3 lines) gets executed one after another. After executing the last statement within the scope of for() the control proceeds to the third part of the loop where it increments the value of looping variable i by 1 , so that the variable is getting the next consecutive higher value i.e. i = 1. Hence the first Iteration of the for( ) loop is finished.

Now at the start of the next iteration the control flow directly proceeds to the second part of the for loop to evaluate looping-condition i.e. 1 <= 3 which is true , the flow of control then proceeds in the similar way as it did in the first iteration and this is repeated till the looping-condition becomes false i.e. when i will become equal to 4 .

Let us put all the things discussed above in the form of an iteration tracking table :

Iteration	i	Looping condition	Output
Starting of loop	0	0<=3 → true	Arun Kumar Kamal Kant Gupta Anil Kumar
End of 1st Iteration	i++ → 1	1<= 3 → true	Same as above
End of 2nd Iteration	i++ → 2	2<= 3 → true	Same as above

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End of 3rd Iteration	i++ → 3	3<=3 → true	Same as above
End of 4th Iteration	i++ → 4	4<=3 → false	No entry into for block , loop is terminated

Observe the above table carefully to find that the loop has executed for 4 times, and the last value of the iterative variable on the termination of loop is 4.

Variations in for( ) loop :

All the three parts of a for loop are optional part i.e. they may or may not be present. Observe the valid variation in syntax of for( ) loop :

> **variation-1 :**

> In the above for( ) loop the first part has been left i.e. we have not declared and initialized the iterator in for( ) , though it has been declared outside the scope of for( ).

> **variation-2 :**

> In the above variation-2 the loop is not having first and second part defined for it, though the execution of the program remains same as version 1 since iterator has been declared and the condition for terminating the loop is implemented through a **if-else** construct inside the loop. You may observe that to terminate the loop we have used the **break statement.** Whenever a break statement is found in a particular construct 's scope it immediately comes out of the current scope.

> **Variation-3** :

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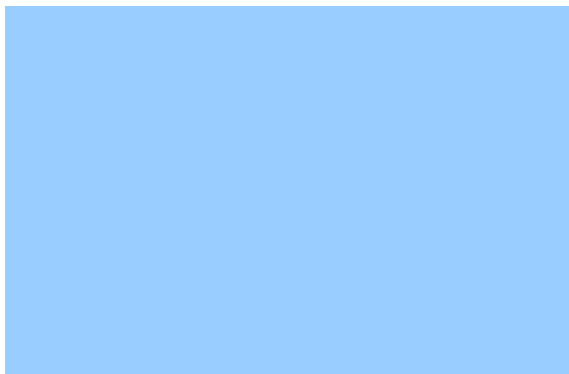
The above variation-3 is implemented in a similar to that of the variation-3 but it has its incrementation statement defined within if( ) construct.

In all of the above variations you might have observed that **it is compulsory to put a semicolon (;) within for( ) even when statements before and after it are absent.**

2.3 : Nested Loops

Students in section 2.1.7 we have seen that any conditional construct can be nested within any other conditional construct. Similarly any looping construct can also be nested within any other looping construct and conditional constructs.

Let us look at the following example showing the nesting of a for( ) loop within the scope of another for( ) loop :

Outer for( ) loop
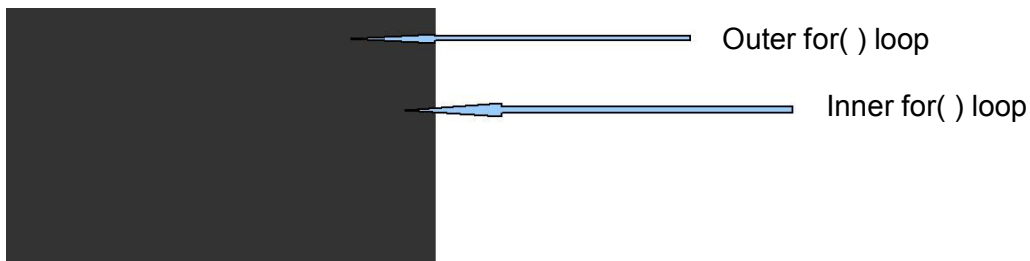
Inner for( ) loop

For each iteration of the outer for loop the inner for loop will iterate fully up to the last value of inner loop iterator. The situation can be understood more clearly as :

1st Outer Iteration
        i= 1
                1st Inner Iteration
                        j = 1 , output : 1 * 1 = 1
                2nd Inner Iteration
                        j = 2 , output : 1 * 2 = 2
                3rd Inner Iteration
                        j = 3 , output : 1 * 3 = 3

2nd Outer Iteration
        i= 2
                1st Inner Iteration
                        j = 1 , output : 2 * 1 = 1
                2nd Inner Iteration
                        j = 2 , output : 2 * 2 = 4
                3rd Inner Iteration
                        j = 3 , output : 2 * 3 = 6

You can observe that j is iterated from 1 to 2 every time i is iterated once.

Workout Yourself :

Write a program to print a multiplication table from 1 to 10 using concept of nested for loop

Let us summarize what we have learned till now :

Check your progress:

1. Write C++ program to sum of following series:

i) $S = 1 + \dfrac{1}{2} + \dfrac{1}{3} + \dfrac{1}{4} + \dfrac{1}{5} + \dfrac{1}{6} + ...+ nterms$

ii) $S = 1 + \dfrac{1}{1} \cdot 2 + \dfrac{1}{2} \cdot 3 + \dfrac{1}{3} \cdot 4 + ...+ nterms$

iii) $S = 1 - 2 + 3 - 5 + 6 - 7 + ...$ n terms

iv) $S = 1 + \dfrac{1}{x!} + \dfrac{2^2}{(x-1)!} + \dfrac{3^3}{(x-2)!} + ... \dfrac{n^n}{(x-n)!}$

2. Using while loop find the sum of digits of number if the inputted number is prime, if number is

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then print the nearest prime number.

For example: if user inputs number = 17 then the output would be = 1 + 7 = 8
                        if user inputs number = 20 then the output would be = 23 (next prime to 20)

3.   You might be knowing DNA in Biology , it is a genetic molecule made of four basic types of
      nucleotides. The four nucleotides are given one letter abbreviations as shorthand for the
      four bases.

      A is for adenine
      G is for guanine
      C is for cytosine

T is for thymine

When considering the structure of DNA it is made of two strands. Each of these strands are made
of long chains of above nucleotides like :

      AAGCTCAGAGCTATG 1st strand

      TTCGAGTCTCGATAC   2nd strand

Each of the nucleotide of 1st strand pairs with nucleotide in other strand using bond. These
bonding obeys the following rule:

      I) A will always pair with T and vice versa II)
      G will always pair with C and vice versa
as it can be observed in the two strands given above.

Write a program in C++ which allows user to input the nucleotide character sequence of 1st strand and
print the probable sequence of the other strand. The user must provided opportunity to input a strand of
any size, and only stops when user inputs an out of order character instead of A , G , C , & T.

Chapter -3

Functions in C++

Objectives :

- to analyze how modularity is implemented in a program at its lowest level.
- To appreciate the use and importance of function in C++
- to program different types of functions and implement them practically.
- To understand difference between User Define Function and Library function.

3.1: Why to use functions ?

Who likes unnecessary repetition of task ? No body in this world. Every body thinks of re usability these days in every aspect of life. What will you do if your cycle wheel rim breaks down on fine day? Do you will throw the whole cycle or sell the cycle as scrap? No exactly not because cycles are designed in such a way that each of its parts can be repaired or replaced. So you will get a new cycle rim from market and will get it fitted in your cycle! This design of cycle where each of its parts have its own unique functionality and could be reassembled together to form a complete cycle is known as **Modular approach of designing**. Each of the cycles part can thought as a Module which serves some purpose in the whole cycle but is very essential for proper functioning of the cycle. The whole concept is nothing but based on **"Divide and Rule philosophy".** A bigger system is divided into smaller components so that each of these smaller parts could handled easily and effectively. These smaller parts when integrated gives rise to the bigger system.

Just think GOD has also created human beings as a modular entity ! We humans have a body which is integration of organ system and each of these organ system is again integration of some organs. So here organs are acting as modules. These modules (organs) could be taken care of individually when we often fall ill.

Can you rightly describe what is opposite word for modularity ? Any system which is not modular is known as monolithic (अखंड)or indivisible. A monolithic system does not have any parts or modules, from top to bottom it is one piece.

Software industry has also adopted the modular approach of design where a big software is divided into several modules. Each of the modules are designed for performing specialized task in the whole software. These modules interact with other modules of the system to carry out essential functionality of the whole system.

Each module during its course of execution repeats same type of task, so whenever the whole system requires a specific type of task , for which a particular module is responsible , it calls or invokes that module and the task is done. This calling of module to perform a certain action , can be done several number of times while the software as a whole executes.

Let us understand the above concept with the help of a real life example. Suppose our KVS is going to develop a centralized software for managing all Kvs across the country. While designing such a software KVS has to divide the whole operation of the software into three big modules called as : Admin , Academic and Accounts, each of these modules could be again broken down into many simple and small sub-modules like Admin Module can have Admission , Construction , Recruitment, etc. whereas the Academics can again have sub-modules like Student Registration, Examination , Results etc.

The following diagram describes the whole concept very easily :

```
                    ┌──────────────────────────┐
                    │  KVS Management Software │
                    └──────────────────────────┘
                                  │
        ┌─────────────────────────┼─────────────────────────┐
        ▼                         ▼                         ▼
  ┌───────────┐           ┌───────────┐             ┌───────────┐
  │   Admin   │           │ Academics │             │ Accounts  │
  └───────────┘           └───────────┘             └───────────┘
```

Sub-modules	Sub-modules	Sub-modules
– Admission	– Student Registration	– Pay&Allowances
– Construction	– Examination	– Audit
– Recruitment	– Results	– Purchase
:	:	:
:	:	:
:	:	:
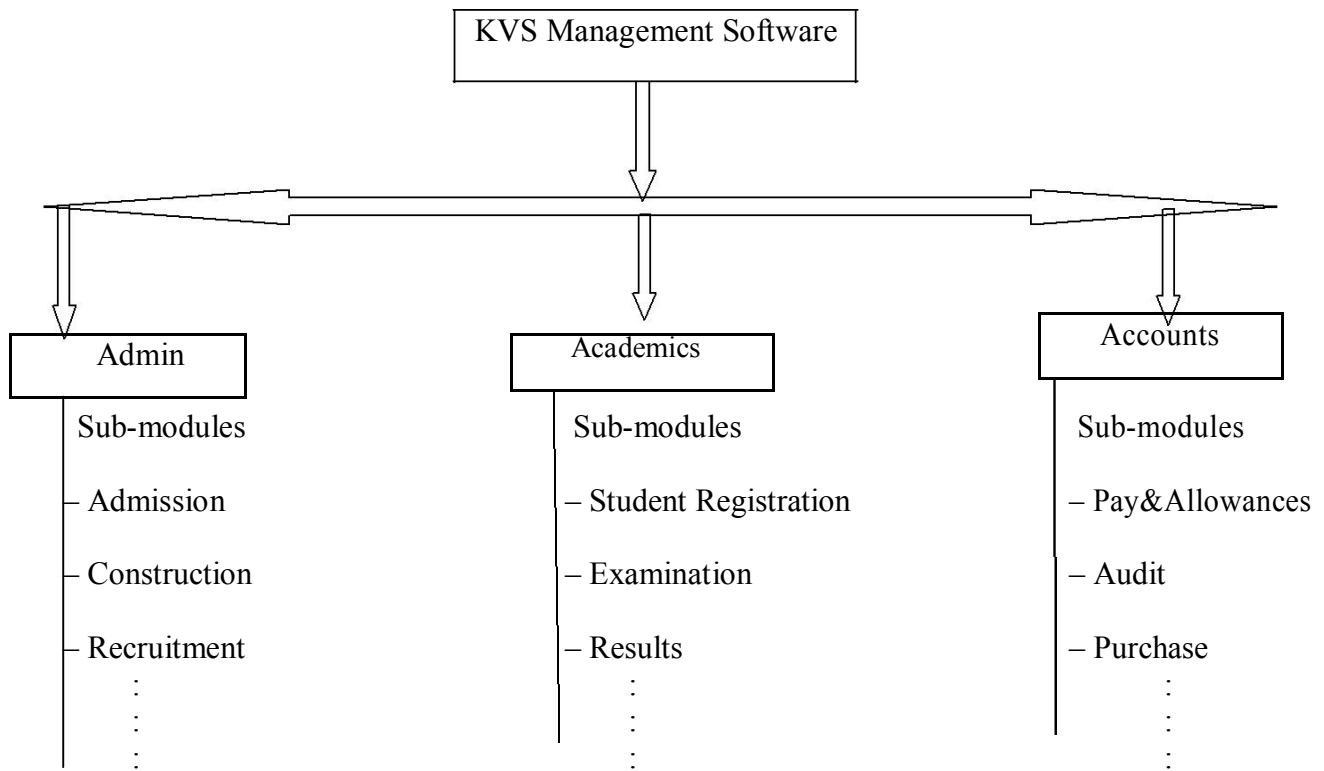
When the whole software is divided into modules as seen in the above case scenario then the following benefits could be harvested :

    i) Each module can be tracked individually and separately without taking much care of other modules.

    ii) A module is a reusable piece of program which could used again and again. Suppose that Navodaya Vidyalaya now wants to make a software like KVS then they can re-use the same modules of KVS with some changes (customization).

    iii) If error is found in one module the functionality of that particular module and its associated modules would be disturbed, the whole software will not suffer. Thus errors can be tracked easily and debugged in much less time, because programmer will know which module is causing error, so he will debug that particular module only not the whole software (much like

when you visit doctor suffering from common cold , the doctor does not checks your brain!)

    iv) System up gradation (the process of changing from older system to newer one) becomes much easier because only those modules which needs up gradation will be dealt leaving other things as it is.

So we see that modularization of a system gives us much independence and flexibility in terms of fast program development , easier debugging , and re-usability.

How Functions in C++ are related to program modules :

Just as a software is divided into modules , each modules into sub-modules , a sub-module is further divided into several functions. So we may call a **function as a micro-level module** of a bigger software.

A function in C++ :
- is smaller section of code of bigger module/program.
- is re-usable piece of code.
- is very specific in nature as it performs a specific task.
- is often called many times in a program.

Thus a C++ function have all the advantages which a module has in a software.

3.2: <mark>Types of function :</mark>

Functions in C++ are of two basic types :
a) User Defined   :   written by a programmer as per his/her requirement domain.
b) Library Function   :   already available with C++ compiler and stored as Library, from where they can be called and used in any C++ program.

3.2.1 : User Defined Functions :

A user define function in C++ is always created by programmer according to his/her program requirements. Suppose, if some programmer is making software for school management then his list of user defined functions may have functions such as : getFee( ) , calcResult( ) , setExam( ) , all these functions will be used only in school management software not any where else, as they are specially tailored function for school management software.

Let us see the syntax to declare a user defined function :

Function Declaration :

where :
return type := is the value which the function returns , if function does not returns any value then we may write there void.
function_name := any valid C++ identifier name

parameter list := declaration of variables of different data types separated by comma these values are inputs passed from outside to the function.

The function declaration as per the syntax given above is also called as **prototype declaration.**
In C++ it is compulsory to declare prototype of a function before defining and using it .

The parameter variable in the declaration are also called **Formal parameters.**

Function Definition :

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While function definition described about the structure of a function , its inputs and output type , the definition of function actually implements the code of the function. While defining a function we add

C++ code to its block as per requirement.

Syntax :

Example : Declare and define a function which finds the sum of two integers and returns it.

```
int getSum( int , int );  // declaration of a function

int  getSum( int a , int b )  // definition of the function
{

}
```

The above function declaration has a return type as integer , because the function is meant to return a sum of two numbers. Two numbers to be added are passed to the function as input parameter. The parameter list is having two int separated by a comma (,) it is not compulsory to write a variable names of the parameters in declaration. A semicolon is terminating the declaration of function.

The definition of function is having code written within its scope where the sum is calculated over the passed parameters a and b and the result is returned using a **keyword return.** It is compulsory that the return data type must be same as that of the datatype of the variable returned using return statement.

Workout yourself :

Declare the prototype of a function which :

i) multiplies three integers and return the product
ii) checks whether a passed integer parameter is even or odd
iii) prints your name 20 times.

Consider the few more definition of functions related to various program :

Function *3.1* :

```
        // function to check whether a given number is prime or
    not int isPrime(int );
    int isPrime(int num )
    {
        int count = 0;
        for( int i = 1 ; i <= num ;
          i++) if( num % I == 0)
            count++;
```

```
                    if (count > 2 )
                        return 0 ; // more than two factors means it is not prime , hence a false value is returned else

                        return 1 ;    // exactly two factors i.e. 1 and num itself means num is prime , hence return a
                                      // true value i.e. 1
            }
```

In the above function if the passed parameter to the function i.e. num would be a prime it will have exactly two factors counted out in variable count and if not would have more than 2 factors. After we conduct a looping over the num to check its divisibility by every value from 1 to num we get count incremented whenever num is divisible by i (looping-variable). So on the termination of loop the variable count stores the total number of times num gets divisible in the loop.

We check this count value to find whether it is more than two or not, if it is more than two it means num has more than two factors and hence it does not satisfies to be a prime , hence we return an integer 0 to designate that it is not prime , other wise we return 1.

Instead of returning 1 and 0 from function you directly print using cout that num is prime or not, but then don't forget to change the return type of the function **isPrime( ) to void.**

Function 3.2 :

```
        // function to print all even numbers found between two given integer parameters

        void findSum( int , int);
        void findSum(int i , int j )
        {
                int sum =
                0; if( i <= j)
                {
                  for( int k = i ; k<= j ; k++)
                        if( k % 2 == 0)
                            cout<< k << — ‚‖;
                }
                else
                    cout<< —Range not valid‖;
        }
```

Explanation :

In the above function there was no need of returning any value from its scope, we have to print the even numbers found within the for loop. Since a function can return only one value at a time, and once its returns a value the scope of the function finishes all the variables declared in its scope dies off and are no more available to be used again. So instead of returning we printed the multiple outputs using a cout. Look how we have declared the function return type as void when we are not returning any value from its scope.

Function *3.3 :*

```
        // program to find the HCF of two inputted numbers :
        void getHCF( );
```

```cpp
void getHCF( )
{
        int n1 = 0 , n2 =
        0; int hcf = 0;
        cout<< —Input two numbers whose hcf is to be
        found‖; cin>>n1>>n2;
        if( n1 == n2 )
          cout<< n1;
        else if( n1 < n2)
        {
           for( int d = 1 ; d <= n2 ; d++)
           {
               if( n1 % d == 0 && n2 % d == 0)
               {
                       hcf = d;
               }
           }
           cout<< —The hcf is — << hcf ;
        }
        else
        {

           for( int d = 1 ; d <= n1 ; d++)
           {
               if( n1 % d == 0 && n2 % d == 0)
               {
                       hcf = d;
               }
           }
           cout<< —The hcf is — << hcf ;
        }
} // end of function
```

Explanation :

Look at the function definition of the above function , since the function is taking the two required inputs within its scope using cout and cin, we had not passed any parameters to function thus we have kept the paranthesis ( ) empty. Also as the function directly prints the output there is no need to return any value from its scope, hence return type is void.

The logic of the function is simple : we are finding the highest of the two numbers and then running a loop from 1 to the highest number and in each iteration we are finding out whether the iterator value divides both the numbers , if it then we put that iterator's value into variable hcf , changing the old value of variable hcf. Thus at the end of the loop the hcf is left out with the Highest Common Factor and we print it with a cout.

Function 3.4 :

        // function to find the Simple Interest on a given principal , rate , and time where the default value of the
        // time parameter is kept 1 yr.

        float getSimpleInt(float , float , float=1);
        float getSimpleInt(float p , float rate , float time)

```
        {
                float si = (p * rate * time)/100;
                return si;
        }
```

The above program is having a new type of parameter known as **default parameter.** A C++ function parameter can be made default if that parameter is assigned any constant either at the time of

declaring it or at the time of its definition. When we associate a default value to a parameter as we have associated 1 with last parameter, then this value will be used if the function is getting called without passing this parameter in the call. This we will again see ahead while discussing a function call. The logic of the program is quite easy to understand. Anyway default parameters must be always declared from right to left, otherwise will cause error. i.e you can't make principal alone as default. Following declaration is Invalid.

            float SimpleInt(float p = 1000 , float rate , float t=1);
    or
            float SimpleInt(float p , float rate = 2 , float t);

If you want to make principal as default parameter you have to make all the parameters on its right side default as well.

So the valid declaration in such case would be :

3.2.2 : Calling a C++ Function from a program :

You might be wondering that err!! in the above few function examples , the author has forgot to write a main( ) function (**a main is also a function!) ,** then **how the code written within the scope of the function would be executed?** You might be also wondering that in The general syntax of calling a function would be in above functions 3.1 , 3.2 and 3.4 the **author has not asked the user to input values for variables used in these functions?**

So students it done knowingly , the codes within the scope of a function never gets executed if it not called from the scope of other scope. Just like your badly damaged non-functional land-line is not going to repaired of its own until unless you are not calling a mechanic! . **So a function has to be called from the scope of another function so that the code within the scope of the function works.** Usually we make this call from the scope of main( ) function, **but we can call a function from the scope of any other function if the called function is defined globally.**

The other doubt that author has not provided the input values in few function is also reasonable because a **user should input the parameter values, if not error will be given.** A **user inputs the parameter values from the same scope where from it calls the function.**

Let us know see the syntax of calling a function :

A function call for a non-returning type function (return type is void) :

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A function call for a non-returning type function (return type is some **datatype**) :

While calling a function the value of the parameter are also called **actual parameter**.

Now let us call all the four functions which we have defined earlier i.e. Finction 3.1 to 3.4

//calling of function 3.1 : int isPrime(int); from main( )

```
void main ( )
{
   int val = 0;
   cout<<‖input a integer to be
   checked‖; cin>> val;


   int r = isPrime( val );   //second type of calling

   if ( r == 1 )
    cout<< val << ― is prime‖ ;  // function is returning 1 only when it found the num be
                                 // a prime value.
   else
     cout<< val << ― is not a prime‖ ;
}
```

//calling of function 3.2 : void findSum(int , int); from main( )

```
void main ( )
{
   int v1 = 0 , v2 = 0;
   cout<<‖input two integer to be
   checked‖; cin>>v1>>v2;

   int s = findSum( v1 , v2); //second type of calling

     cout<< ―The sum is‖<< s ;  // function returns the sum which is caught by s and
                                 // shown!!
}
```

//calling of function 3.3 : void getHCF( ); from main( )

```
void main ( )
{
```

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```
        getHCF( ); //first type of calling
                    // though it appears that this type of calling is an easier method, but it is
                    // rarely used in actual software making industries.
    }
```

//calling of function 3.4 : float getSimpleInt(float , float , float=1);; from main( ) ; we may call this
//function a different ways let us see

```
        void main()
        {
                float prnc = 5000, rt = 10 , tm = 5;
                float si = 0.0;
                // first call produces si : Rs 2500

                si = getSimpleInt(prnc , rt , tm);

                // second call produces si = Rs. 500

                si = getSimpleInt(prnc , rt ); // last parameter is omitted as it was declared as
                                               // as optional type with a default value = 1
        }
```

3.2.3 : Arguments passed by value and by reference

Until now, in all the functions we have seen, the arguments passed to the functions have been passed
by value. This means that when calling a function with parameters, what we have passed to the
function were copies of their values but never the variables themselves. For example, suppose that
we called our first function addition using the following code:

```
    int x=5, y=3, z;
    z = addition ( x , y );
```

What we did in this case was to call to function addition passing the values of x and y, i.e. 5 and 3
respectively, but not the variables x and y themselves.

```
int addition (int a, int b)
                 ↑       ↑
z = addition (  5  ,   3  );
```

This way, when the function addition is called, the value of its local variables a and b become 5 and 3
respectively, but any modification to either a or b within the function addition will not have any effect
in the values of x and y outside it, because variables x and y were not themselves passed to the
function, but only copies of their values at the moment the function was called.

But there might be some cases where you need to manipulate from inside a function the value of an
external variable. For that purpose we can use arguments passed by reference, as in the function
duplicate of the following example:

// passing parameters by reference
#include <iostream.h>

```
    void duplicate (int& a, int& b, int& c)
```

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```
        {
            a*=2;
            b*=2;
            c*=2;
        }

            int main ()
            {
                int x=1, y=3, z=7;
                duplicate (x, y, z);
                cout << "x=" << x << ", y=" << y << ", z=" <<
                z; return 0;
            }
```
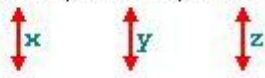
output : x=2, y=6, z=14

The first thing that should call your attention is that in the declaration of duplicate the type of each parameter was followed by an ampersand sign (&). This ampersand is what specifies that their corresponding arguments are to be passed *by reference* instead of *by value*.

When a variable is passed by reference we are not passing a copy of its value, but we are somehow passing the variable itself to the function and any modification that we do to the local variables will have an effect in their counterpart variables passed as arguments in the call to the function.

To explain it in another way, we associate a, b and c with the arguments passed on the function call (x, y and z) and any change that we do on a within the function will affect the value of x outside it. Any change that we do on b will affect y, and the same with c and z.

That is why our program's output, that shows the values stored in x, y and z after the call to duplicate, shows the values of all the three variables of main doubled.

If when declaring the following function:
        void duplicate (int& a, int& b, int& c)
we had declared it this way:
        void duplicate (int a, int b, int c)

i.e., without the ampersand signs (&), we would have not passed the variables by reference, but a copy of their values instead, and therefore, the output on screen of our program would have been the values of x, y and z without having been modified.

Passing by reference is also an effective way to allow a function to return more than one value. For example, here is a function that returns the previous and next numbers of the first parameter passed.

// more than one returning value

```
        #include <iostream.h>
        void prevnext (int x, int& prev, int& next)
        {
        prev = x-1;
```

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```
            next = x+1;
            }

            int main ()
            {
              int x=100, y, z;
              prevnext (x, y, z);
              cout << "Previous=" << y << ", Next=" << z;
             return 0;

            }
```
Ouput :Previous=99, Next=101

3.2.4 : Arguments passed as const parameter

Look at the following protoype :

        void myFunction(const int x = 10);

The above function is declaring its first parameter as const i.e even if the user tries to pass value to this argument the new value will not change the value assigned to the const parameter, even in the scope of the function also it will remain unchaged.

Let us see one example :

```
        void myFunction( const int x = 10 )
        {
             cout<< x;
        }

        main( )
        {
              myFunction(3 ); // even if the function is passed with a value 3 it will not accept.
        }
```

The output of the code will be 10 instead of 3.
So whenever you don't want to restrict your parameter to a fixed value , declare it as const.
Some compiler may produce error.

check your progress :

1.   Write a function (waf) to find the largest out of three integers as input parameters.
2.   W.a.f to find whether a number either divisible by its predecessor and successor.
3.   W.a.f which returns the sum of digits of any integer passed to it as parameter.
4.   W.a.f to calculate discount amount on a given rate of item and discount % offered.

3.1.2 : Library Functions :

These functions are ready-made functions available with C++ compiler. They are stored under various header files. A header file is a normal C++ program file with .h extension containing the code for all the C++ functions defined under it. Header files group functions according to its use and common feature.

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Following are some important Header files and useful functions within them :

1.   stdio.h (standard I/O function)   :   gets( ) , puts( )
2.   ctype.h (character type function)   :   isalnum( ) , isalpha( )
                                                        isdigit ( ), islower ( ),isupper ( ), tolower ( ),
                                                        toupper( )

3.   string.h (string related function)   :   strcpy ( ), strcat ( )
                                                         strlen( ), strcmp( ) , strcmpi( ) , strrev( )
                                                         strupr( ) , strlwr( )

4.   math.h (mathematical function)   :   fabs ( ), pow ( ), sqrt ( ), sin ( ), cos ( ),
                                                         abs ( )

5.   stdlib.h   :   randomize ( ), random ( ), itoa( ) , atoi().

The above list is just few of the header files and functions available under them , but actually there are many more. If you want to learn their use go to the help menu of your turbo C++ compiler and search out function list and learn its prototype.

The calling of library function is just like User defined function , with just few differences as follows:

Library functions also may or may not return values. If it is returning some values then the value should be assigned to appropriate variable with valid datatype.

Let us deal with each of these library functions by calling the them from programs :

gets( ) and puts( ) : these functions are used to input and output strings on the console during program run-time.

        gets( ) accept a string input from user to be stored in a character array.
        puts() displays a string output to user stored in a character array.

program 3.1 :

```
// program to use gets( ) and puts( )
    #include<iostream.h>
    #include<stdio.h> // must include this line so that gets( ) , puts( ) could be linked and called
    void main( )
    {
            char myname[25] ;  //declaring a character array of size 25

            cout<<‖input your name : ―;
            gets(myname) ; // just pass the array name into the parameter of the function.
            cout<< ―You have inputted your name as : ― ;
            puts(myname);
    }
```

i**salnum( ) , isalpha( ), isdigit( ) :** checks whether the character which is passed as parameter to them are alphanumeric or alphabetic or a digit ('0' to '9') . If checking is true functions returns 1.

program 3.2 :

```
// program to use isalnum( ) , isalpha( ), isdigit(
    ) #include<iostream.h>
    #include<ctype.h>
    void main( )
    {
            char ch;
            cout<<‖Input a
            character‖; cin>>ch;
            if( isdigit(ch) == 1)
              cout<<‖The inputed character is a
            digit‖; else if(isalnum(ch) == 1)
              cout<<‖The inputed character is an
            alphanumeric‖; else if(isalpha(ch) == 1)
                cout<<‖The inputed character is an alphabet.
    }
```

islower ( ),isupper ( ), tolower ( ), toupper( ) : islower( ) checks whether a character has lower case , isupper( ) does opposite. tolower( ) converts any character passed to it in its lower case and the toupper( ) does opposite.

program 3.3:

```
// program to use islower ( ),isupper ( ), tolower ( ), toupper(
    ) #include<iostream.h>
    #include<ctype.h>
    void main( )
    {
            char ch;
            cout<<‖Input a
            character‖; cin>>ch;
            if( isupper(ch) == 1)   // checks if character is in upper case converts the character to lowercase
            {
              tolower(ch);
              cout<<ch;
            }
            else if(islower(ch) == 1)  // checks if character is in lower case converts the character to
            {                                // uppercase
              toupper(ch);
              cout<<ch;
            }
    }
```

fabs ( ), pow ( ), sqrt ( ), sin ( ), cos ( ), abs ( ) :

Program 3.4

```
#include <iostream.h>
#include <math.h>
#define PI 3.14159265 // macro definition PI will always hold 3.14159265
```

int main ()

```
{

 cout<<"The absolute value of 3.1416 is : —<<fabs (3.1416) ; // abs( ) also acts similarly but only on int
 data cout<<"The absolute value of -10.6 is "<< fabs (-10.6) ;
 cout<<‖7.0 ^ 3 = " <<pow (7.0,3); cout<<"4.73
 ^ 12 = " << pow (4.73,12); cout<<"32.01 ^
 1.54 = "<<pow (32.01,1.54);

  double param, result;
  param = 1024.0;
  result = sqrt (param);
  cout<<"sqrt() = "<<result ;

  result = sin (param*PI/180); // in similar way cos( ) , tan() will be called.
  cout<<"The sine of — <<param<<‖ degrees is : "<< result ;

  return 0;
}
```

randomize ( ), random ( ), itoa( ) , atoi():

The above functions belongs to header file stdlib.h . Let us observe the use of these functions :

 randomize( ) : This function provides the seed value and an algorithm to help random( ) function in generating random numbers. The seed value may be taken from current system's time.

random(<int>) : This function accepts an integer parameter say x and then generates a random value between 0 to x-1

for example : random(7) will generate numbers between 0 to 6.

To generate random numbers between a lower and upper limit we can use following formula :
       random(U – L +1) + L
 where U and L are the Upper limit and Lower limit values between which we want to find out random values.

For example : If we want to find random numbers between 10 to 100 then we have to write code as :

       random(100 -10 +1) + 10 ;   // generates random number between 10 to 100

Check you progress :

1. Name the header files to which the following functions belongs:

       i) toupper( )   , ii) fabs( ) ,   iii) sqrt( ) , iv) strcpy( )

2. Write a program to check whether a string variable is palidrome or not , using only library function.

----------------------------x--------------------end of chapter 3-----------------x--------------------------------

Summary :

1. Functions provides modularity to programs.

2. Functions can be re-used.

3. Functions can be of two types : User Defined and Library.

4. We have to declare and define user define functions either in program-scope or header files to use them in a program.

5. To use library functions appropriate header files must be included using #include directive

6. A prototype of a function means , the number , data-types and sequence of its parameters.

7. During function call it is very necessary to pass parameter values (actual parameters) to the function in the same order and type as define in its prototype.

8. The Library functions are kept within header files. These header files are made as per the working nature of the function.

9. A big software must use modular approach of programming to which function is as essential programming element.

10. Sometimes instead of passing values as parameters to the function we pass its references to the function. This type of calling is known as call by reference.

Chapter - 4

Structured Data Types : Arrays and Structures.

Objectives :
- to understand the meaning of structure datatypes and its availability in C++.
- To appreciate the use and importance of Arrays in C++
- to differentiate between the use and implementation of different types of Arrays
- To use structures as User Defined data type to write programs.
- To understand and use typedef

Structured Data types :

Students till now whatever data type we have used are just primitive data types like int , char , float , etc. All these datatypes are defined within the C++ compiler and that is why they are also called as primitive. We can define a length using int , a weight using float , a name using characters etc. but suppose I tell you —please define a fruit for me in program‖ ,then your mind starts wondering, as you can't define a fruit just with any one datatype as you did with length , weight etc.

A Fruit itself is a composite entity having following attributes :

color	:	can be described with a name i.e. char [ ]
taste	:	can be described with a name i.e. char[ ]
season	:	can be described with int i.e. 1 for summer , 2 for winter …
price	:	can be described as float

ans so on...

This means that to describe a fruit we need to have a collection of data-types bundled togeather so that all the attributes of the fruit can be captured. This is true for any real world thing around you say student , mobile , plant etc. So when we bundle many primitive data types together to define a real world thing then it is known as **derived data type or structured data type or User defined data types.**

In this chapter we would look onto two important structured data types , one is **Array** and the other one is **Structure**.

Sometimes we need to have variables in very large quantities , that too of same data type i.e. suppose we want 200 integer variables. In this situation will you declare 200 individual variables ? Absolutely not. This is because it will :

a) wastage of time as well time taking task

b) we won't be able to manage these 200 variables in our program , it will be difficult to remember the names of variable every now and then during programming.

So there exist special structured data type in C++ to tackle this situation. C++ allows a programmer to bundle together all these same type of 200 variable under a same tag name called as Arrays.

So we are observing that **structuring data type means bundling primitive data type in some or other way so that it solves some special programming situations.**

4.1 Arrays

An array is a series of elements of the same type placed in contiguous memory locations that can be individually referenced by adding an index to a unique identifier.

That means that, for example, we can store 5 values of type int in an array without having to declare 5 different variables, each one with a different identifier. Instead of that, using an array we can store 5 different values of the same type, int for example, with a unique identifier.

For example, an array to contain 5 integer values of type int called myArr could be represented like this:

```
myArr       0           1           2           3           4

        +-------+-------+-------+-------+-------+
        |       |       |       |       |       |
        +-------+-------+-------+-------+-------+
        |--------------- |
              int
```
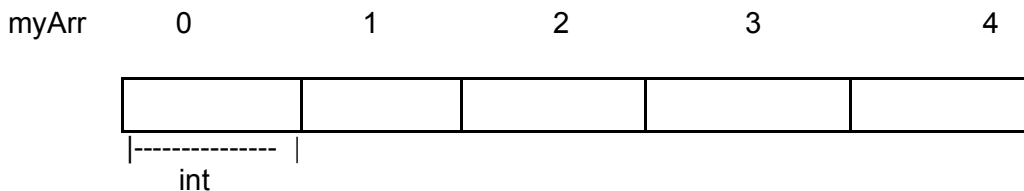
where each blank panel represents an element of the array, that in this case are integer values of type int. These elements are numbered from 0 to 4 since in arrays the first index is always 0, independently of its length.

Like a regular variable, an array must be declared before it is used. A typical declaration for an array in C++ is:

Syntax :

where datatype is a valid type (like int, float...), name is a valid identifier and the elements field (which is always enclosed in square brackets [ ]), specifies how many of these elements the array has to contain.

Therefore, in order to declare an array called myArr as the one shown in the above diagram it is as simple as:

int **myArr [5];**

NOTE: The elements field within brackets [ ] which represents the number of elements the array is going to hold, must be a **constant** value, since arrays are blocks of non-dynamic memory whose size must be determined before execution. In order to create arrays with a variable length dynamic memory is needed, which is explained later in these tutorials.

Initializing arrays.

When declaring a regular array of local scope (within a function, for example), if we do not specify otherwise, its elements will not be initialized to any value by default, so their content will be undetermined until we store some value in them. The elements of global and static arrays, on the other hand, are automatically initialized with their default values, which for all fundamental types this means they are filled with zeros.

In both cases, local and global, when we declare an array, we have the possibility to assign initial values to each one of its elements by enclosing the values in braces { }. For example:

int **myArr [5] = { 16, 2, 77, 40, 12071 };**

This declaration would have created an array like this:

```
           0          1          2          3          4
billy |    16   |     2   |    77  |    40   |   12071  |
```

The amount of values between braces { } must not be larger than the number of elements that we declare for the array between square brackets [ ]. For example, in the example of array myArr we have declared that it has 5 elements and in the list of initial values within braces { } we have specified 5 values, one for each element.

When an initialization of values is provided for an array, C++ allows the possibility of leaving the square brackets empty [ ]. In this case, the compiler will assume a size for the array that matches the number of values included between braces { }:

> *int* myArr [ ] = { 16, 2, 77, 40, 12071 };

After this declaration, array myArr would be 5 ints long, since we have provided 5 initialization values.

Accessing the values of an array.

In any point of a program in which an array is visible, we can access the value of any of its elements individually as if it was a normal variable, thus being able to both read and modify its value. The format is as simple as:

Syntax:

Following the previous examples in which myArr had 5 elements and each of those elements was of type int, the name which we can use to refer to each element is the following:

For example, to store the value 75 in the third element of myArr, we could write the following
> statement: **myArr[2] = 75;**

and, for example, to pass the value of the third element of myArr to a variable called a, we could write:
> a = myArr[2];

Therefore, the expression myArr[2] is for all purposes like a variable of type int.

Notice that the third element of myArr is specified myArr[2], since the first one is myArr[0], the second one is myArr[1], and therefore, the third one is myArr[2]. By this same reason, its last element is myArr[4]. Therefore, if we write myArr[5], we would be accessing the sixth element of myArr and therefore exceeding the size of the array.

In C++ it is syntactically correct to exceed the valid range of indices for an array. This can create problems, since accessing out-of-range elements do not cause compilation errors but can cause runtime errors. The reason why this is allowed will be seen further ahead when we begin to use pointers.

At this point it is important to be able to clearly distinguish between the two uses that brackets [ ] have related to arrays. They perform two different tasks: one is to specify the size of arrays when they are declared; and the second one is to specify indices for concrete array elements. Do not confuse these two possible uses of brackets [ ] with arrays.

> *int* myArr[5]; *// declaration of a new array* myArr[2] =
> 75; *// access to an element of the array.*

If you read carefully, you will see that a type specifier always precedes a variable or array declaration, while it never precedes an access.

Some other valid operations with

arrays: myArr[0] = a;

myArr[a] = 75; b
= myArr [a+2];
myArr[myArr[a]] = myArr[2] + 5;

program 4.1

// adding all the elements of an array

```
#include <iostream>
using namespace std;

int myArr [] = {16, 2, 77, 40, 12071};
int n, result=0;

int main ()
{
  for ( n=0 ; n<5 ; n++ )
  {
    result += myArr[n];
  }
cout << result;
return 0;
}
```

Output :   12206

Dynamic Initialization:

Arrays can also be initialized during runtime. The following program shows how to input values into arrays during rum time :

program 4.2

```
// Inputting value in an array during run-
time #include<iostream.h>
main()
{
        int my_arr[5];      // name of array.
        cout<<‖\nEnter values at: ―;
        for(int i = 0 ; i < 5; i++)
        {
                cout<<‖\n‖<<i+1<<‖ :‖;
                cin>>my_arr[ i ];                    //stores value at ith index.
        }
}
```

//program 4.3

```
// program to store 10 integers and show them.
#include<iostream.h>
main()
{
        int my_arr[5];      // name of array.
```

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```cpp
                        cout<<"\nEnter values at: ";
                        for(int i = 0 ; i < 10; i++)
                        {
                                cout<<"\n"<<i+1<<" :";
                                cin>>my_arr[ i ];                       //stores value at ith index.
                        }
                        for(int i = 0 ; i < 10; i++)
                        {
                                cout<<"\Number at "<<i+1<<" :"<<my_arr[ i ];  //show value at ith index.
                        }

        }
//program 4.4
// program to search a particular value out of linear array :
        #include<iostream.h>
        #include<stdio.h>
        #include<process.h>
        main( )
        {
                int a[10] , val = 0; cout<<"Input
                ten integers : ";
                            // inputting array
                value for(int i = 0 ; i<=9 ; i++)
                {
                    cin>> a[i];
                }
                // searching element
                for(int i = 0 ; i<=9 ; i++)
                {
                    if(a[i] == val)
                    {
                            cout<<"Element found at index location : " <<
                            i; getch();
                            exit();  // if element is found no need to further search, terminate program
                    }
                    // if control flow reaches here that means if( ) in the loop was never
                    satisfied cout<<"Element not found";
        }
```

```cpp
// program 4.5
// program to find the maximum and minimum of an array :
        #include<iostream.h>
        main( )
        {
                int arr[ ] = {10, 6 , -9 , 17 , 34 , 20 , 34 ,-2 ,92 ,22 };
                int max = min = arr[0];
                for(int i = 0 ; i<= 9 ; i++)
                {
                        if(arr[i] < min)
                         min= arr[i];
                        if(arr[i] > max)
                         max = arr[i];
                }
```

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```
                    cout<<‖The minimum of all is : ─ << min<<‖and the maximum is : ─ <<max;
        }
```

Check your progress :

1. Write a program to store 10 elements and increase its value by 5 and show the array.
2. Write the program to divide each of the array element by 3 and show the array.
3. Write a program to find the average of all elements of an array of size 20.
4. Write a program to find second minimum value out of an array containing 10 elements.

4.2 Strings : Array of characters

Strings are in fact sequences of characters, we can represent them also as plain arrays of char elements terminated by a '\0' character.

For example, the following array:
        char myStr [20];

is an array that can store up to 20 elements of type char. It can be represented as:

myStr

'H'	'e'	'l'	'l'	'o'	'\0'														
0	1	2	3	4	…			…			…								19

Therefore, in this array, in theory, we can store sequences of characters up to 20 characters long. But we can also store shorter sequences. For example, myStr could store at some point in a program either the sequence "Hello" or the sequence "Merry christmas", since both are shorter than 20 characters.

Therefore, since the array of characters can store shorter sequences than its total length, a special character is used to signal the end of the valid sequence: the null character, whose literal constant can be written as '\0' (backslash, zero).

Our array of 20 elements of type char, called myStr, can be represented storing the characters sequence "Merry Christmas" as:

myStr

'M'	'e'	'r'	'r'	'y'		'C'	'h'	'r'	'i'	's'	't'	'm'	'a'	's'	'\0'				
0	1	2	3	4 …			…				…								19

Notice how after the valid content a null character ('\0') has been included in order to indicate the end of the sequence. The panels in gray color represent char elements with undetermined values.

Initialization of null-terminated character sequences

Because arrays of characters are ordinary arrays they follow all their same rules. For example, if we want to initialize an array of characters with some predetermined sequence of characters we can do it just like any other array:

        char myword[ ] = { 'H', 'e', 'l', 'l', 'o', '\0' };

In this case we would have declared an array of 6 elements of type char initialized with the characters that form the word "Hello" plus a null character '\0' at the end.

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But arrays of char elements have an additional method to initialize their values: using string literals.

In the expressions we have used in some examples in previous chapters, constants that represent entire strings of characters have already showed up several times. These are specified enclosing the text to become a string literal between double quotes ("). For example:
"the result is: "   is a constant string literal that we have probably used already.

Double quoted strings (") are literal constants whose type is in fact a null-terminated array of characters. So string literals enclosed between double quotes always have a null character ('\0') automatically appended at the end.

Therefore we can initialize the array of char elements called myword with a null-terminated sequence of characters by either one of these two methods:

```
char myword [ ] = { 'H', 'e', 'l', 'l', 'o', '\0'
}; char myword [ ] = "Hello";
```

In both cases the array of characters myword is declared with a size of 6 elements of type char: the 5 characters that compose the word "Hello" plus a final null character ('\0') which specifies the end of the sequence and that, in the second case, when using double quotes (") it is appended automatically.

Please notice that we are talking about initializing an array of characters in the moment it is being declared, and not about assigning values to them once they have already been declared. In fact because this type of null-terminated arrays of characters are regular arrays we have the same restrictions that we have with any other array, so we are not able to copy blocks of data with an assignment operation.

Assuming mystext is a char[] variable, expressions within a source code like:

```
mystext = "Hello";
mystext[] = "Hello";
```

would **not** be valid, like neither would be:
```
mystext = { 'H', 'e', 'l', 'l', 'o', '\0' };
```

The reason for this may become more comprehensible once you know a bit more about pointers, since then it will be clarified that an array is in fact a constant pointer pointing to a block of memory.
Using null-terminated sequences of characters

Null-terminated sequences of characters are the natural way of treating strings in C++, so they can be used as such in many procedures. In fact, regular string literals have this type (char[]) and can also be used in most cases.

For example, cin and cout support null-terminated sequences as valid containers for sequences of characters, so they can be used directly to extract strings of characters from cin or to insert them into cout. For example:

```
//program 4.6
//null-terminated sequences of characters

        #include <iostream.h>
        int main ()
        {
                char question[ ] = "Please, enter your first name: ";
                char greeting[ ] = "Hello, ";
                char yourname [80];
                cout << question;
```
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```
        cin >> yourname;
        cout << greeting << yourname <<
        "!"; return 0;
}
```

output : Please, enter your first name: John
            Hello, John!

As you can see, we have declared three arrays of char elements. The first two were initialized with string literal constants, while the third one was left uninitialized. In any case, we have to specify the size of the array: in the first two (question and greeting) the size was implicitly defined by the length of the literal constant they were initialized to. While for yourname we have explicitly specified that it has a size of 80 chars.

```
//Program 4. 7
// program to count total number of vowels present in a string :
#include<iostream.h>
#include<stdio.h>
int main( )
{
        char string[35]; int count =
        0; cout<<‖Input a string‖;
        gets(string); // library function in stdio.h to input a string for(int i = 0
        ; string[i] != '/0' ; i++)
        {
          if( string[i] == 'a' || string[i] == 'e' || string[i] == 'o' || string[i] == 'u' || string[i] == 'i'
                || string[i] == 'A' || string[i] == 'E' || string[i] == 'O' || string[i] == 'U' || string[i] == 'I' )
          {
                count++;
          }
        }
}
```
 In the above program the loop is iterated till the character at ith location matches with null character, because after that there is no character left to be scanned. So scanning of characters from first to last character is done using for loop and if vowels are found count keeps incrementing.

String related library functions :

There are few string related library functions in header file string.h which are very useful when we work with strings. They are :

  i) **strlen(char[ ]) :** it accepts a string as parameter and returns the length of the string i.e. number of characters within the string. For example strlen(―Hurray‖) will return 6.

  ii) **strcpy(char[ ] , char[ ]) :** it accepts two strings as input parameters and then copies the second into the first. For example :

```
        char mstr[ ] = ―Suresh‖;
        char ystr[20];
        strcpy(ystr , mstr); // copies content of mstr into ystr
        puts(mstr); // prints Suresh
```

  iii) **strrev(char[ ]) :** it accepts a string , reverses its content and stores it back into the same string. For example :
```
              char    myName[    ]    =
              ―Kamal‖; strrev(myName);
              puts(myName) ;   // prints the reversed string as ―lamaK‖
```

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iv) **strcmp(char[ ] , char[ ])** : it accepts two parameters and then compares their content alphabetically, the one which comes first in the acsii chart has considered to be lower. This function returns the value as integer. The integer can be :

        0   : if the two strings are equal
        +val   : if the first string is bigger than the second
        -ve   : if the second string is bigger than the first.

The above comparison is case sensitive , if we want to perform case insensitive comparison then we have to take another version of the function called as strcmpi( )

        Example :
                if(strcmpi(―Kamal‖ , ―kamal‖) !=
                    0); cout<<‖Not equal‖;
                else
                    cout<<‖equal‖;

4.3 Multidimensional arrays

Multidimensional arrays can be described as "arrays of arrays". For example, a two dimensional array can be imagined as a bidimensional table made of elements, all of them of a same uniform data type.

twoDArr represents a bidimensional array of 3 per 5 elements of type int. The way to declare this array in C++ would be:

        int twoDArr [3][5];

and, for example, the way to reference the second element vertically and fourth horizontally in an expression would be:

        twoDArr[1][3]
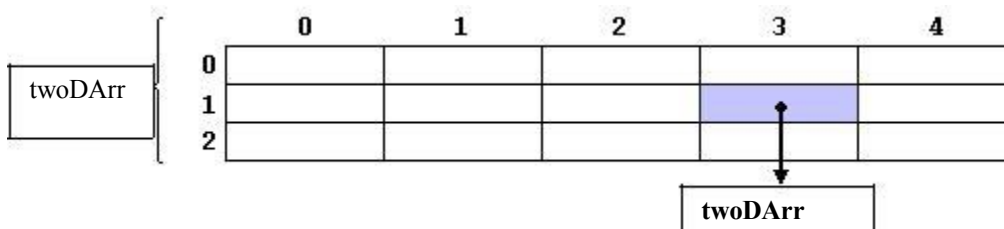
(remember that array indices always begin by zero).

Multidimensional arrays are not limited to two indices (i.e., two dimensions). They can contain as many indices as needed. But be careful! The amount of memory needed for an array rapidly increases with each dimension. For example:

        char alpha [100][365][24][60][60];

declares an array with a char element for each second in a alpha, that is more than 3 billion chars. So this declaration would consume more than 3 gigabytes of memory!

Program 4.2
// program to show use of a 2D array

        #define WIDTH 5
        #define HEIGHT 3

```
        int twoDArr
        [HEIGHT][WIDTH]; int n,m;

        int main ()
        {
                for (n=0;n<HEIGHT;n++)
                for (m=0;m<WIDTH;m++)
                {
                        twoDArr[n][m]=(n+1)*(m+1);
                }
                return 0;
        }
```

We have used "defined constants" (#define macro) to simplify possible future modifications of the program. For example, in case that we decided to enlarge the array to a height of 4 instead of 3 it could be done simply by changing the line:

        #define HEIGHT 3
to:
        #define HEIGHT 4

with no need to make any other modifications to the program.

Arrays as parameters
At some moment we may need to pass an array to a function as a parameter. In C++ it is not possible to pass a complete block of memory by value as a parameter to a function, but we are allowed to pass its address. In practice this has almost the same effect and it is a much faster and more efficient operation.

In order to accept arrays as parameters the only thing that we have to do when declaring the function is to specify in its parameters the element type of the array, an identifier and a pair of void brackets []. For example, the following function:

        void procedure (*int* arg[])

accepts a parameter of type "array of int" called arg. In order to pass to this function an array declared as:

        int myarray [40];

it would be enough to write a call like
        this: procedure (myarray);

4.2 <mark>Structures In C++</mark>

4.2.1 : Why Structures???

To understand the basic need let us proceed with a sample programming scenario.
Problem Definition :

Mr. Chamanlal is Human resource manager in a construction company. He has different responsibilities related to manpower and its utilities. One of his main duties is to keep the record of data related to the Workers who are working in the construction company.

The information which is to be kept regarding a Worker are :

> Name
> Sex   Data members
> Age
> Rate per day.

Chamanlal wants to write a C++ program which can keep track of the information related to all Workers working in the construction company.

Solution : The above problem could be solved in C++ using 3 ways. They are :

> Using Simple variables to store all information of each employees
      > Using Arrays to store related information of each employees
      > Using C++ Structures

Let us explore all these three techniques to store information of each Worker of the company. Assuming that there are total 20 Workers.

Using Variables :

As we have learned in class XI that any type of data could be stored in a C++ variable having a suitable data type. For example in the given problem the following data types must be used to store information related to a Worker :

Data	Data Type	C++ Declaration	Total Size in bytes
Name	char	char name[45] ;	45 x 1 = 45 bytes
Sex	char	char sex = _M'	1 x 1 = 1 byte
Age	int	int age = 15 ;	1 x 2 = 2 bytes
Rate per Day	float	float rate = 100.00 ;	1 x 4 = 4 bytes.

So to store the information of 20 Workers one has to declare a total of
: 4 x 20 = 80 variables

The variable declarations in the program would be like : char
name1[45] , name2[45] , name3[45] , … , name20[45] ;

char gender1 , gender2 , gender3 , … , gender4 ;

int age1 , age2 , age 3 , … , age20 ;

float rate1 , rate2 , rate3 , … , rate20 ;

Conclusion :

Using the above methodology , we find that as the number of worker increases the number of variables also increases , and thus it becomes difficult task to manage these huge number of variables.

Using Arrays

The drawbacks of the previous method of information storage could be managed up to some extent , if instead of taking separate variables for storing related information of Workers (say Age) , we could have used an array of Age , which would store the age of all 20 employees.

Though this method does not provides a economic solution in terms of memory , it provides a better management of Memory locations , where the information about the employees would be stored. So, four different arrays would be required to keep the related information of Workers i,e :

        1. An array to keep the Names of the Workers
        2. An array to keep the Gender of the Workers
        3. An array to keep the Age of the Workers
        4.An array to keep the Rate of the Workers.

1.Array to keep Names :

"Ramu"	"Hari"	"kajri"	…	"Bajrangi"
Name[0]	name[1] name[2]	…		name[19]

Declaration : **char name[20]45] ;**

2. Array to keep Gender:

'M'	'M'	'F'	…	'M'
Gender[0]	gender[1]	gender[2]	…..	gender[19]

Declaration : **char gender[20];**

3. Array to keep Age:

18	22	24	…	19
age[0]	age[1]	age[2]	…	age[19]

Declaration : **int age[20];**

4. Array to keep Rate:

100	120	140	…	100
rate[0]	rate[1]	rate[2]	…	rate[19]

Declaration : **float rate[20];**

Using C++ Structures :

The previous method of storing related data of Workers in different Arrays is a better a solution than storing them in several separate variables. Though it provides better management of information but as the information related to a Worker increases (Say , along with Name , Age , Sex , and Rate , we also want to store Date Of Join , Category , SSN etc.) the need for extra Arrays arises , thus Array management would be another cumbersome issue , if we use Arrays to store information of a Worker.

Thus C++ provides us one of its most fascinating programming construct to handle this situation of storing huge amount of related information about similar entities like WORKER.

To solve the given problem using C++ Structure one has to bundle all the information related to a single WORKER under one single tag name. **This Bundle of information related to an entity,with a Tag Name is called Structure.**

"Ramu"	"Hari"	"kajri"	…	"Bajrangi"

Bundled together to form a structure having data related to the worker "RAMU"

'M'	'M'	'F'	…	'M'

18	22	24	…	19

100	120	140	…	100

Let us now have a look at the syntax for creating a structure :

A Structure in C++ is created by using the Keyword struct. The General Syntax for creating a Structure is :

Syntax :

struct < Name of Structure >

Example :

A Proper example following the previous syntax could be :

struct WORKER ———— Structure name
{
    char name[45];
    char gender ; data-member int age ;

    float rate ;
} W1 , W2 , W3 ;

structure variable representing 3 workers.

Points to remember :

1. A structure can declared locally (inside main( )) or globally (Outside main( )).
//local declaration
main( )
{

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```
            struct WORKER
            {
               char name[45];char gender;…
            } W1 , W2 , W3;
               …
               ...
        }
```

In this case we can create structure variable only within main( )

```
        //Global declaration
        struct WORKER
        {
            char name[45];char gender;…
        };
        main( )
        {
            WORKER W1 , W2 , W3 ;
        …… }
```

In this case we can create structure variable anywhere in the program

If declared globally , the structure variables could be declared both from inside main( ) and any other place outside main( ) function including any other user defined functions.

If declared locally , the structure variables could be declared only within the scope in which the structure has been defined.

2. No data member should be initialized with any value within the structure declaration. i,e the following type of structure declaration is incorrect and cause error :

```
        struct WORKER
        {
            char name[45];
            gender = _M';          Invalid Initialization within structure scope
            age = 16;
            rate = 100.00;
        };
```

4.2.2 : <mark>Structure Variable Initialization</mark>

Structure variables could be initialized by two ways :
- Static Initialization (During design time)
- Dynamic Initialization (Passing values during Runtime)

Static Initialization :

WORKER w1 ; // structure variable declaration

w1.name = —Ramull;
w1.gender = _M'; // static
initializations w1.age = 17;
w1.rate = 100.00;

The (.) operator here is known as component operator, used to access the data members composing the structure variable.

There is also one another way for static initialization :

WORKER w1 = { ―Ram‖ , ‗M' , 17 , 100.00 };

Warning : The declaration as well as initialization should be in the same line.

Dynamic Initialization :

```
main( )
{
        WORKER w1 ;
        cout<< ―Input Worker's Name‖;cin.getline(w1.name , 45);
        cout<< ―Input Worker's Gender‖;cin >> w1.gender ;
        …
}
```

4.2.3 Structure variable assignments

We know that every variable in C++ can be assigned any other variable of same data type i,e :
        if int a = 7 ; b = 3;
        we can write :
                a = b ; // assigning the value of b to variable a

Similar is the case with Structure variables also , i,e :
        if WORKER w1 = {―Ramu‖ , ‗M' , 17 ,
        100.00}; WORKER w2;
        we can write :
        w2 = w1 ; // assigning the corresponding individual // data member values of w1 to Worker w2;
or
        WORKER w2 = w1;
Note : Both structure variables must be of same type i,e WORKER.

There is a member wise copying of member-wise copying from one structure variable into other variable when we are using assignment operator between them.

So, it is concluded that :
        Writing : w1. name = w1.name
        ; w1.gender = w2.gender ;
        w1.age = w2.age ;
        w1.rate = w2.rate ;

is same as :
        w1 = w2 ;

Though we can copy the contents of similar types of structure variables , two dissimilar types of structure variables can't be assigned to each other, even though they may have same types of constituent data members. Assigning values into dissimilar structure variable would cause a incompatible data type error

Consider the two different structures Student , and Worker :

The Student structure can be written as :

        struct Student

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```
        {
          char name[45];
          char gender;
          int age ;
          float height;
        };
```

Compared to Worker Structure , we find that , the data types and sequence of all the data members of structure student is same as that of structure Worker, but still we can never write :

Worker w = {―Ramull , _M' , 20 , 5.5};

So the following assignments are invalid assignments :

        Student s = w ;   // Invalid assignment as s and w both are two different structures
or
        Student s ;
        s = w;   //Invalid

4.2.4 Array of Structure :

Just like we can make array of integers , floats , chars we can also make array of user defined data types like structures. The syntax to make such an array is :

        <structure_name> <array_name>[size];

        where : structure_name is the name of the structure which you have created.
                    array_name is any valid identifier
                    size is a positive integer constant.

        Example : to create array of 20 Workers we can have :

            Worker W[20];

The above structure could be visualized as :
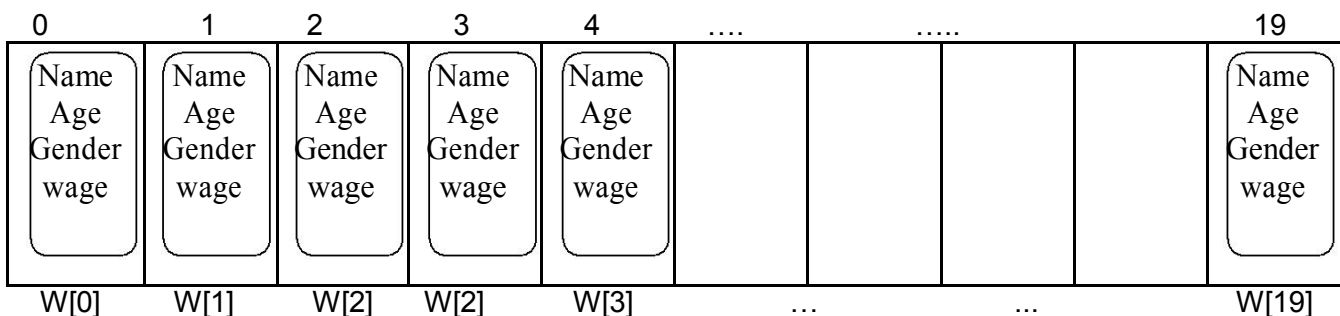
Each of the elements of the array is itself a structure hence each of them have all the four components.

Initialization of Structure Array :

Array of structures like any other array can be initialized statically and dynamically (runtime).

Static initialization : The above array of Workers W[ ] can be statically initialized as :

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```
W[ ] = {
            { —Ramull, 'M' , 17 , 100.00 },
            { —Harill , 'M' , 22 , 120.00 },
            { —kajrill , 'F' , 18 , 100.00 },

              …                    //values of other 16 workers.
              …
            {—Bajrangill , 'M' , 24  , 140.00 }
     };
```

Note : The data-member values must be supplied in the same order of the data-member described in structure definition , otherwise datatype mismatch error may cause.

Dynamic Initialization :

```
#include<iostream.h>
#include<stdio.h>
main( )
{
     Worker W[20] ;       // consider the Worker structure declared earlier.
```



```
}
```

4.2.5 : Function with Structure variable:

Just like we can pass various primitive datatypes to a function we can also pass a structure variable as function parameter / arguments. The benefit is that the structure carries a bundled information to the structure. The prototype of such a function would be :

```
<return_type> function_name(<structure_name> <var> , … , … );
```

Let us understand the concept with following program :

```
//program  4.8
// program to write a function which increases the wage of a female worker by passed percent

     void increaseWage(  Worker & w , float incr )
     {
            if( w.gender == 'F' || w.gender == 'f' )
            {
```

```
                    w.wage + = w.wage* (incr /100) ;
            }
    }
```

Look at the highlighted parameter, we have passed formal structure variable as reference, so that the increment is reflected back in actual parameter.

Similarly , if we don't want to pass our structure variable as reference we can do so , but then we have to return the modified structure variable back. This can be achieved in above function, if we take return type as structure name. Let us modify the function so that it returns a structure :

```
        Worker increaseWage( Worker w , float incr)
        {
                if( w.gender == 'F' || w.gender == 'f' )
                {
                        w.wage + = w.wage* (incr /100) ;
                }
            return w ;
        }
```

4.2.6 : Use of typedef statement :

A typedef can be used to indicate how a variable represents something. This means that we are defining another name for an existing datatype. Let us see the following example to understand this.

Suppose we are going to write a program in C++ where we need lot of strings of size 30 say. This means that every time we have to declare character array of size 30 , like char arr[30] or so. Instead of declaring each time with size specification if we have a declaration like :

string arr ;

which automatically instructs the compiler that arr will be a character array of size 30 , then this will give a good look to our program. We can achieve this by using typedef statement as done in the program given below :

```
        #include<iostream.h>
        typedef char string[30] ;
        main( )
        {
                string name ;
                cout<<‖Input your
                name‖; gets(name);
                cout<<‖You name has  —<< strlen(name)<<‖ciharacters‖;
        }
```

The second line defines a new datatype named as string which is nothing but array of 30 characters.

Check your Progress :

Q1.   consider the structure distance given below :

```
        struct Distance
        {
                int feets , inches; };
```

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Now answer the following :

    i) what does feets and inches known as ?

    ii) declare a variable of type Distance and initialize it statically.

    iii) Can we use = operator between two Distance type variables. If yes, what does it infers?

    iv) write a function which takes two Distance variable as parameters and then returns their sum. For example say D1 = {9 , 6 } and D2 = {5 , 8 } , then D1 + D2 = 15 feet 2 inches

    v) Declare an array representing 10 Distances , and then write a program to initialize all these 10 distances and then increase all the distances by 5 feets.

Q2. Consider the structure called Point as :

```
struct Point
{
        int xCoord;
        int yCoord;
};
```

Write a function which accepts three Points as parameter and then checks whether the three points are collinear.

Q3. Consider the following structure called Element and Compound :

```
struct Element
{
        int atomic_no;
        float atomic_mass;
        char symbol[2];
        int valency;
};
struct Compound
{
        Element Elements[ 5 ]; // array to keep all elements present in the compound.
        float molecular_mass;
};
```

Write a program to initialize a compound and show its details.

Summary :

1. Structured data types are used in special programming situations like arrays are used when there is bulk of similar type of variables to deal with, whereas structures models a real life entity having some attribute.

2. Arrays can have both primitive as well user defined data types. There are basically two types of arrays , one dimensional and multidimensional (2 dimensional)

3. Functions can be passed structured datatypes as its parameter as well as they can return them.

4. typedef is a special keyword to define a another name for a variable definition.

Sample Paper Class – I
Subject – Computer Science

Time: 3Hours
Maximum Marks: 70

Note. (i) All questions are compulsory.

1 a) What are the different functions of operating system?   2
   b) How the information can be used as a data explain ?   2
   c)What do you mean by unary operators   2
   d) What are the different parts of CPU? Explain every part in brief.   2
   e) Define System Software and what are its two main types? Give examples.2
   f) What is Booting?   1
   g) Which of the following are hardware and software?   1
    (i) Capacitor (ii) Internet Explorer (iii) Hard disk (iv) UNIX
2. Explain the following term: (Give answer any six)   6

   i) Variable
   ii) Token
   iii) Array
   iv) Debugging
   v) Comment
   vi) Keyword

3 a) What is the difference b/w **"while"** & —do **while**‖ loop?   2
   b) What are data types? What are all predefined data types in c++?   2
   c) What will be the size of following constants?   1
      „\v","\v",
 d) Write the corresponding C++ expressions for the following mathematical expressions:
1
      i) $\sqrt{(a^2+b^2)}$ (ii) $(a+b)/(p+q)^2$
 e) Evaluate the following, where p, q are integers and r, f are floating point
      numbers. The value of p=8, q=4 and r=2.5
   (i)   f = p * q + p/q
   (ii)   r = p+q + p % q   2

4 a) What is the output of the following?   2
     i) # include<iostream.h>
       void main ( )
           {
            int i=0;

                 cout<<i++<<‖ ‖<<i++<<‖ ‖<<i++<<endl;
                 cout<<++i<<‖ ‖<<++i<<‖ ‖<<++i<<endl
           }
   ii) # include<iostream.h>
      void main( )
           {
           a=3;
           a=a+1;
           if (a>5)
                  cout<<a;
            else
                 cout<<(a+5);

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```
                    }                                                        2
iii) What will be the output of the following program segment?              3
       If input is as:         (a) g        (b) b    (c) e    (d) p


       cin >>ch;
       switch (ch)
        { case _g': cout<<‖Good‖;
          case _b': cout<<‖Bad‖;
                    break;
          case _e': cout<<‖ excellent ‖;
                    break;
          default: cout<<‖ wrong choice‖;
        }
   iv) Determine the output:
                                                                            2

      for(i=20;i<=100;i+=10)
        {
        j=i/2;
        cout<<j<<‖‖;
        }
   v) What output will be the following code fragment produce?
        void main( )
                {
                int val, res, n=1000;
                cin>>val;
                res = n+val >1750 ? 400:200;
            cout<<res;
                }
      (i) if val=2000    (ii) if    val=1000 (iii) if val=500                3




5 a) Find the error from the following code segment and rewrite the corrected code underlining the correction
made.                                                                       2

  # include(iostream.h)
        void main ( )
        int X,Y;
        cin>>>X;
        for(Y=0,Y<10,
          Y++) if X= =Y
                  cout<<Y+X;
          else
                cout>>Y;        }
  b) Convert the following code segment into switch case construct.        3

   int ch;
     cin>>ch;
     If(ch = = 1)
     {     cout<<― Laptop‖;
     }
       else If(ch = = 2)
          {
          cout<<―Desktop ‖;
          }   else if(ch= = 3)
```

```
                {
                  cout<<―Notebook‖;
                } else
                      {
                  cout<<―Invalid Choice‖;
                      }
            }
        }
```

c) Convert the following code segment into do-while loop.   3
```
        #include<iostream.h>
        void main()
          { int i;
           for(i=1;i<=20;++i)
               cout<<‖\n‖<<i;
          }
```

d) Given the following code
   fragment int ch=5;
   cout << ++ch<< ―\n‖<<ch<<‖\n‖;

   i)   What output does the above code fragment produce?
   ii)What is the effect of replacing ++ ch with ch+1?   2

6 a) Which header files are required for the following?
   (i) frexp()((ii) sqrt( ) (iii) rand( ) (iv) isupper()   2

 b) Evaluate: 4
 i) $(12)_{10} = (X)_2$
 ii) $(347)_8 = (X)_{10}$
 iii) $(896)_{16} = (X)_8$
 iv) $(100)_{10} = (X)_2$

7 a) Write a C++ program to check a year for leap year or not.   2
 b) Write a C++ program to check a number for Armstrong or not.   4
 c) Write a C++ program to calculate the factorial of any given number   4
 d) Write a C++ program to print the Fibonacci series   4
 e) Write a C++ program to print table a given number.   2

Q.No.1

a. Major OS functions are listed below

   1.Process Management 2. Storage Management 3. Information
   Management (Student has to describe all in brief)

b. The processed information can be used as a data again to produce a next level information.
   For example- totoal no. of students school wise can give the information that how students
   are there in one region again this information as a data ca be used to calculate that how
   many students are studying in KVS

c. unary operators are the operators, having one operand and two operators. There are two
   types of unary operators-
     i. unary increment (Ex. a++(post increment))/++a(pre increment))
     ii. Unary decrement (a—(post decrement)/--a(pre decrement))

d. ALU(Arithmetic logic unit), CU(control unit), MU(memory unit)

e. System software are the software that govern the operation of computer system
   and make the hardware run. These software can be classified into two categories.
   Operating System & Language Processor

f. Booting is a process through which operating system makes the computer system ready to
   perform user's task

g. Hardware- I&III, Software- II&IV

Q.No.2

 i. variable is a name given to the memory location, whose value can be changed during run time.

ii. The smallest individual unit in a program is known as a token

iii. Array is a combination of similar data values. It is used to store more than one value under same
    name

iv. debugging is a way to correct the errors in the program during compilation

v.comments are non executable statements, used to give the information about the code for future
  use.

vi.Keywords are the reserved words, programed by the programmer to perform the specific task. The
   keyword can not be taken as a name of variable.

Q.No.3

a. While loop is entry control loop i.e. while loop first will test the condition and if condition is
    true then only the body of the loop will be executed. While do-while loop is exit control loop
    and even the condition is not true at least one time the body of the loop will be executed.

b. data types are means to identify the types of data and associated operation of handling it.
The fundamental data types are- char, int , float , double and void .

c. one byte

d. i. sqrt(a*a+b*b) & ii. ((a+b)/((p+q)*(p+q))

e. students do yourself

Q.No.4

 a.   i. 0 1 2

            4 5 6 , ii. 9 , iii. For g- good & bad/ for b – bad / for e – excellent / for – p wrong choice
       iv. 10,15,20,25,30,35,40,45,50 v. 400, 400, 200

Q.No.5

a. Errors – if x==y (correct- if(x==y)) & cout>>y(correct cout<<y)

b.
```
   int ch; cin>>ch;
   switch(ch)
       {
            Case 1 : cout<<— Laptop‖; break;
            Case 2: cout<<—Desktop ‖; break;
            Case 3: cout<<—Notebook‖;break;
            Default : cout<<—Invalid Choice‖;
```

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```
        }
c. #include<iostream.h>
        void main()
            { int i;
             i=1 do

                { cout<<‖\n‖<<i;
                    ++i
                }while (i<=20);
            }
```
d. In both condition output will be 6 5

Q.No.6
   a. math.h , math.h , stdlib.h , ctype.h
   b. 1100, (232) , (4226), (1100100)

Q.No.7
   a.
   #include<iostream.h>
   #include<conio.h>

   void main()
   {
    clrscr();
    int year;
    cout<<"Enter
    Year(ex:1900):"; cin>>year;
    if(year%100==0)
    {
     if(year%400==0)
      cout<<"\nLeap Year";
    }
     else
      if(year%4==0)
       cout<<"\nLeap Year";
      else
       cout<<"\nNot a Leap
     Year"; getch();
    }
b.
#include<iostream.h>
#include<conio.h>
void main()
{
int Number,Temp,b=0;
cout<<endl<<"Enter any number to check";
cin>>Number;
Temp=Number;
int P;
while(Temp>0)
{
 P=Temp%10;
 b=b P*P*P;
 Temp=Temp/10;
}

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```

```cpp
if(b==Number)
{
 Cout<<endl<<"Armstrong no";
}
else
{
 cout<<"Not an armstrong no";
}
getch();
}
```

c.
```cpp
#include <iostream.h>
int factorial(int);

void main(void)
{ int number;

cout << "Please enter a positive integer: ";
cin >> number;
if (number < 1)
cout << "That is not a positive integer.\n";
else
cout << number << " factorial is: " << factorial(number) << endl;
}

int factorial(int number) {

if(number <= 1) return
1; else
return number * factorial(number - 1);
}
```
d.
```cpp
#include<iostream.h>
#include<conio.h>
int main()
{
        clrscr();
        unsigned long first,second,third,n;
        int i;
        first=0;
        second=1;
        cout<<"how many elements(>5)? \n";
        cin>>n;
        cout<<"fibonacci series\n";
        cout<<first<<"  "<<second;
        for(i=2;i<n;i++)
        {
                third=first+second;
                cout<<" "<<third;
                first=second;
                Second=third;
        }
        return 0;
        getch();}
```

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e.

```
#include<iostream.h>
#include<stdio.h>
void main()
{
int r,m,i,n;
cout<<"Enter the number to generate its
table"; cin>>n;
cout<<"Enter the number(table
upto)"; cin>>m;
i=1;
while(i<=m)
{
r=n*i;
cout<<N<<"*"<<I<<"="<<R<<endl;
}

}
```

Sample Paper - II
Subject – Computer Science

Max Marks 70   Duration 3 hrs

Note:- All questions are compulsory

Q1)
 a) What is significance of My Computer   ?   2

 b) Explain different types of operating systems .   1

c) What is an Operating System? Explain its any two functions   2

d) How is a compiler different from interpreter?   2

e) Convert

   (i) (10.10)$_{10}$= (?)$_2$

   (ii) (101011.1110)$_2$ =(?)$_{10}$ 2

Q2)
a) What do you mean by run time error?   1

b) what is the deference between if and if – else statement   2

c) Mention and explain briefly any three   characteristics of a good program   2

d) How can you give a single line and multiline comments in C++ explain with
   suitable examples   2

e) what do you mean by header files? What is the difference between #include <iostream.h> and
#includelliostream.hll   2

Q3)
a) Classify   the following variable names of c++ into valid and invalid category   2
   (i) 1no (ii) num   1 (iii) num (iv) num1num (v) num+1 (vi) num.1

b) Give output of following code.   3

```
  #include<iostream.h>
int m=5; void check();
void main( )
{ int m=20;
     {
     int m=10*::m;
     cout<<"m="<<m<<"::m="<<::m<<endl; }
     check();
     cout<<"m="<<m<<"::m="<<::m<<endl;
     check(); cout<<"::m="<<::m<<"m="<<m<<endl;
     }
      void check()
      { ++m;

   }
```

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c) What will be result of following statements if a=5 , b=5 initially   2
   (i) ++a<=5 (ii)   b++<=5

d)Name the header file(s) that shall be needed for successful compilation of the
 following C++ code.   2

             void main( )
             {
               char name[40];
               strcpy(name,‖India‖);
               puts(name); }

e) Explain conditional operator (?) with example in c++ .   2

f) What is difference between ‗/‘ and ‗%‘ operators in c++ ? explain with a example
                                                                          2

Q4)

a) What do you mean by function prototype in C++   2

b) Explain Break and Continue statement in C++ with example.   2

c) Find syntax error(s) if any in following program (Assume all header files are present) 2

 main<>
{ int c;
 switch(c);
case 1.5: { cout<<‖ India is great\n‖;
          } break;
‗case‘ 2: { cout<<‖ hello\n‖;
          } break;
} // end of main
} // end of switch

d) How will you declare and define   1
     i)Array named mark with 10 integer values
     ii)array named avg with 8 float values

e) Convert following while loop to for loop   2
int   x=0;
while(x<=100)
{ cout<<‖ the value of x is \n‖<<x;
   cout<<‖done \n‖;
  x+=2;
}

f) Define token ?   1

g) What is the difference between call by value and call by reference explain with
     suitable example   2

h)Find the output of the following program;   **3**

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```
#include<iostream.h>
#include<ctype.h>
void main( )
{ char Text[ ] = —Comp@uter!‖;
for(int I=0; Text[I]!=‘\0‘;I++)
{ if(!isalpha(Text[I]))
Text[I]=‘*‘;
else if(isupper(Text[I]))
Text[I]=Text[I]+1;
else
Text[I] = Text[I+1]; }
cout<<Text; }
```

i) What are differences between for and do- while loop ?   explain with example   2

j) How can you define Global Variable and Local Variable? Also, give a   suitable C++
  code to illustrate both.   2

Q5 : a) Write a program to print the left and right diagonal element of an NXN matrix   4
    b) b. Write a program to find the factorial of a number recursive function.   4
    c) Write a program to find the total number of characters, lines and words in a
     paragraph of text.   4
    d) Write a program to sort an array on N numbers in ascending order. Avoid
     duplication of elements.   4
    e) Write a program to find the roots of a quadratic equation.   4

Q.No.1

a. My Computer is used to viewing the contents of a single folder or drive. Also the things we have on our computer – Your Programs, Documents and data files, for example- are all accessible from form one place called My

Computer. b. Types of operating system -

   i. Single User ii. Multiuser iii. Time Sharing iv. Real Time v. Multiprocessing vi. Interactive

c. An operating system is a program which acts as an interface between a user and the Hardware. Functions- i. Process Management and Storage(Memory) Management.
   Note. Students has to explain both in brief

d. An interpreter converts source program(HLL) into object program(LLL) line by line whereas compiler converts source program into object program in one go and once the program is error free it can be executed later .

Q.No.2

a. An error in logic or arithmetic that must be detected at run time is called run time error. For example any number is divided by zero (c=a/0) is run time error

b. if statement can perform only true condition and there is no option for false condition while if-else statement can perform both true as well as false condition . Example,

   if(a<b) cout<<‖ a is greater than b‖ – in this code for false condition no statement is given if(a<b) cout<<‖ a is greater than b‖
    else
       cout<<‖ b is greater than a‖ – here for both option either true or false output will come

c.

d. Comments in c++ can be given in two way

   Single line comment – which can be given by using the symbol -
     // Example- // Program to find the sum of two numbers
      And Multi line comment – which can be given by using the symbol /*………….*/
    Example -- /* this is the way
             To give multiline Comment */

e. Header files are the files in which some pre – programed program will be stored by the developer of the language which will help the user of to develop their program. If the header file is written in angular bracket(<>) compiler will search it in C++ library only while in case of ― ‖ the header file will be searched throughout the database.

Q.No.3

a. i , ii ,v , vi – are invalid & iii, iv are valid declaration

b. m=5 ::m=5
   m=20 ::m=6
   m=7 ::m=20

c. True and false

d. String.h and stdio.h

e. The conditional operator (**? :**) is a ternary operator (it takes three operands). The conditional operator works as follows:

- The first operand is implicitly converted to **bool**. It is evaluated and all side effects are completed before continuing.
- If the first operand evaluates to **true** (1), the second operand is evaluated.
- If the first operand evaluates to **false** (0), the third operand is evaluated.

The result of the conditional operator is the result of whichever operand is evaluated — the second or the third. Only one of the last two operands is evaluated in a conditional expression
 Ex.- // expre_Expressions_with_the_Conditional_Operator.cpp

```
// compile with: /EHsc
// Demonstrate conditional operator
#include <iostream>
using      namespace
std; int main() {
   int i = 1, j = 2;
   cout << ( i > j ? i : j ) << " is greater." << endl;
}
```

f. Operator / is used to find the quotient while % is used to find the remainder in the c++ expression for ex.
   int a=5,b=2,c; if c=a/b the result of c will be 2 and if c=a%b; the value of c will be 1

Q.No.4
a. A function prototype is a declaration of the function that tells the program about the type of
   the value returned by the function and the number and the type of arguments.
      The prototype declaration looks just like a function definition except that it has no body.
   Ex. void abc();
b. break makes the compiler to transfer the control out of the loop...
for {....

if
{
true/false
condition break;
}
}
here;
the control is transferred to "here"

continue makes the compiler to execute the next iteration of the loop

for
{
Condition..
continue;
****;
}

**** will not b executed and next iteration will
happen continue can be given inside an if condition

e. to j .   Do yourself.

Ans 5
: **a)**
```
        #include<iostream.h>
        #include<conio.h>
        #include<iomanip.h>
        void main( )
        {
                int A[10][10];
                int i,j,N;
                clrscr( );
                cout<<"\nHow many rows and columns required for matrix: ";
```
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```
                    cin>>N;
                    cout<<"\nEnter "<<N*N<<" elements: ";
                    for(i=0;i<N;i++)
                    {
                            cout<<"Enter the elements into Row "<<i+1<<":
                            "; for(j=0;j<N;j++)
                              cin>>A[i][j];
                    }
                    clrscr( );
            }

        cout<<"\nThe entered elements in the matrix are: \n";
        for(i=0;i<N;i++)
        {
                for(j=0;j<N;j++)
                cout<<A[i][j]<<"\t";
                cout<<endl;
        }
        cout<<"\n\n\nThe elements which are belongs to only
        diagonals...\n"; for(i=0;i<N;i++)
        {
          for(j=0;j<N;j++)
            if((i==j)||((i+j)==(N-1)))
                cout<<setw(6)<<A[i][j];
           else
                cout<<" ";
                cout<<endl;
        }
        getch( );
}

 b)

#include<iostream.h>
#include<conio.h>
long f =1;
long factorial(int n)
{
  if (n==0)
    return f;
else f=n*factorial(n-
    1);
}
void main( )
{
    clrscr( );
    long num;
    cout<<"\nEnter the number to which you want to find factorial: ";
    cin>>num;
    cout<<"\nThe factorial of the number = "<<factorial(num);
    getch( );
}

c)
#include<iostream.h>
```

```
#include<conio.h>
#include<stdio.h>
void main( )
{
  char str[300];
  int i,charcount=0,words=1,lines=1;
  clrscr();
  cout<<"\nEnter the Paragraph ie message: \n";
  gets(str);
  for(i=0;str[i]!='\0';i++)
   {
      charcount++;
      if(str[i]==' _)
        words++;
     if (charcount%80==0)
        lines++;
  }
 cout<<"\nNumber of Characters in the entered message:
 "<<charcount; cout<<"\nNumber of Words in the entered message:
 "<<words; cout<<"\nNumber of Lines in the entered message: "<<lines;
 getch( );
}


d)
#include<iostream.h>
#include<conio.h>
void main( )
{
        clrscr( );
        int A[20],N,i,j,temp;
        cout<<‖\nEnter the number of
        elements:‖; cin>>N;
        for(i=0;i<N;i++)
        cin>>A[i];
        //Bubble sort technique
        for(i=0;i<N;++i)
          for(j=0;j<(N-1)-i
            ;j++) if(A[j]>A[j+1])
              {
                 Temp=A[j];
                 A[j]=A[j+1];
                 A[j+1]=Temp;
                 }
cout<<"The Elements in the array after sorting…. ";
for(i=0;i<N;i++){
cout<<A[i]<<'\t';
}

e)

#include<iostream.h>
#include<conio.h>
#include<math.h>
void main( )
```

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```
{
 clrscr( );
 double d1,d2,b,a,c,d;
 cout<<"\nEnter the value of b,a and c: ";
 cin>>b>>a>>c;
d=(b*b-sqrt(4*a*c));
if(d==0)
        cout<<"\nRoots are equal or
distinct"; else if(d>=0)
        cout<<"\nRoots are Real";
 else
 {
    cout<<"\nRoots are complex..ie
    Imaginary"; d1=(-b+d)/(2*a);
    d2=(b+d)/(2*a);
    cout<<"\nD1: "<<d1;
    cout<<"\nD2: "<<d2;
    getch( );
 }
}
```

Time: 3Hours

Maximum Marks: 70

Note. (i) All questions are compulsory.

Q.No.1
   a. Define Analog an Digital Computer
   b. why analytical engine often called the pioneer computer.
   c. what are the different types of printer. Explain in brief
   d. What is the difference between copying and moving files and folders
   e. What functions are performed by an operating system as a resource manager

Q.No.2
   a. Define the term ASCII and ISCII.
   b. What are the different Data representation schemes
   c. Explain different types of RAM
   d. What do you mean by ports. Explain in brief all types of ports   4
   e. Why primary memory is termed as **_destructive write"** memory but _non-destructive read'
      memory
   f. Explain the different features of OOP.   3

Q.No.3
   a) Find the output of the following program.   3

```
#include<iostream.h>
       void Withdef(int HisNum=30)
       {
         for(int I=20;I<=HisNum;I+=5)
         cout<<I<<‖,‖;
         cout<<endl;
       }
       void Control(int &MyNum)
       {
          MyNum+=10;
          Withdef(MyNum);
       }
       void main()
       {
         int YourNum=20;
         Control(YourNum);
         Withdef();
         cout<<‖Number=‖<<YourNum<<endl;
       }

   b. void main()
     {
         char *NAME=‖a ProFiLe!‖; for(int
         x=0;x<strlen(NAME);x++)
         if(islower(NAME[x]))
           NAME[x]=toupper(NAME[x]);
         else
```

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```
        if(isupper(NAME[x]))
          if(x%2!=0)
            NAME[x]=tolower(NAME[x-1]);
        else
            NAME[x]--;
            cout<<NAME<<endl;
    }
```

c. How Many time the following code will be executed
```
        int i = 1 ;
        i= i - 1 ;
        while(i)
        {
                cout<<‖it‘s a while
                loop‖; i++ ;
        }
```
d. What is difference between Actual parameter and Formal parameter? Give an example in C++ to
   illustrate both type of parameters.

e. Explain different jump statements with suitable example.
f. rewrite the following code using do-while loop
```
        int i ;
        for(i=0;i<10;i++)
        {
          cout<<i; i++ cout<<i;
        }
```
g. identify the error(s) in the following code fragment
```
        char ch; int v=0,o=0;
        cout<<‖enter character‖;
        while ((ch>=‘A‘ && ch<=‘Z‘)||( ch>=‘a‘ && ch<=‘z))
        {
         switch(ch) {
                case ‗a‘:
                case ‗e‘:
                case ‗i‘:
                case ‗o‘:
                case ‗u‘:
                case ‗U‘:  ++v;  break;  default  :
        ++o; }cout<<v;<<‖ ‖<<o;
        }
```

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Sample Paper - IV
Subject – Computer Science

Time: 3Hours
Maximum Marks: 70

Note. (i) All questions are compulsory.

Q.No.1.

a. Differentiate between primary memory and secondary memory.. Give examples
of each type of memory.   2

A) The memory inside the CPU is primary memory (main memory) and the memory
outside it is known as secondary(auxiliary) memory.
Primary Memory: RAM (Random Access Memory) and ROM (Read only
Memory) comes under primary memory. RAM is volatile memory and ROM
is non volatile memory. All the data and programs must be stored in RAM for
execution. But the content of RAM is not permanent.
Eg: RAM, ROM.
Secondary Memory: Since primary memory has a limited storage capacity and is
not permanent, secondary storage devices are used to store large amount of data
permanently. There are various types of secondary devices available these days.
Eg: Hard disks, Floppy disks ----- Magnetic Media
CD ROMS, DVDs ----- Optical Media

b. What is the difference between semantics error and syntax error? Give an example of
each. 3

A) 1.Syntax Errors: Syntax errors occur when rules of a programming language are misused.
Syntax refers to formal rules governing the construction of valid statements in a language.
Eg: int a,b //Did not keep ; (semicolon) at the end of statement.
2.Semantics Error: Semantic errors occur when statements are not meaningful.
Semantics refers to the set of rules which give the meaning of a statement.
Eg: X * Y = Z;
(Siva plays Guitar is Syntactically and Semantically correct but
Guitar plays Siva is Syntactically correct but Semantically incorrect).

c. What do you meant by a lexical unit? Give an example.   2

A) Token: The smallest individual unit in a program is known as a token (**Lexical Unit**).
There are 5 types of tokens.
(i) Keywords (ii) Identifiers (iii) Literals (iv) Punctuators (v) Operators
d. what is relation between Microprocessor and Microcomputer   2
Ans. Microcomputer is a computer that contain a Microprocessor
e. Briefly Distinguish between a general purpose and special purpose computer   2

Q.No.2

a. what is the shortcut menu ? what is its significance   2
b. what is the significance of Recycle Bin   2
c. Explain the concept of time sharing   2
d. What is meant by the term multiprogramming and multitasking   2.
e .Explain briefly the function performed by an operating system as processor manager. 2

Q.No.3

a. **4.**Differentiate between object oriented programming and procedural oriented programming with the help of examples of each. 3 A. **Procedure Oriented Programming:**

A program in a procedural language is a list of instructions where each statement tells the computer to do something. The focus is on the processing. There is no much security for the data.

Object Oriented Programming:

The object oriented approach views a problem in terms of objects involved rather than procedure for doing it. In object oriented programming, object represents an entity that can store data and has its interface through functions

b.Distinguish between if and switch statement. 3

A)The if-else and switch both are selection statements and they both let you select an alternative out of given many alternatives by testing an expression.
But there are some differences in their operations.

(i) The switch statement differs from the if statement in that switch can only test for equality whereas if can evaluate a relational or logical expression. Ie multiple conditions.

(ii) The switch statement selects its branches by testing the value of same variable whereas the if else construction lets you use a series of expressions that may involve unrelated variables and complex expressions.

(iii) The if-else can handle ranges whereas switch cannot.

c.Differentiate between call by value and call by reference with help of an example. 4

A)(i)In call by value, actual arguments will be copied into the formal perameters. In call by reference, formal perameters are references to the actual arguments. (ii)In call by value, if any modification is occurred to the formal perameter, that change will not reflect back to the actual argument.

In call by reference, if any modification is occurred to the formal perameter (reference to the actual argument), the actual argument value will be changed.

(iii) We should go for call by value when we don't want to modify the original value.
We should go for call by value when we want to modify the original value.

(iv) Example:
```
void Change(int a, int
&b) { a= 2*a;
b=20;
}
```
Here a is called by ―call by value‖ method and b is called by ―call by reference‖

So as the value of a is changed, actual argument for a will not be changed,
as the value of b is changed, actual argument for b will be changed

d.Write the names of the header files of the following functions.
i)getch() ii) isalpha() iii)strcpy() iv)sqrt() 2

A) (i) getch( ) - conio.h (ii)isalpha( ) – ctype.h
(iii)strcpy( ) - string.h (iv)sqrt( ) - math.h

Q.No.4
a. What will be the output of the following program? 3

```
int main()
{
  int i=0,x=0;
  for(i=1;i<10;i*=2)
  {
   x++;
   cout<<x;
  }
  cout<<‖\n‖<<x;
}
```

b.Rewrite the following program after removing the syntactical error(s) if any.
   Underline each correction.   3

```
#include<iostream.h>
int main
{
  struct movie
   {
     char movie_name[20];
     char movie_type;
     int ticket_cost=100;
   }movie;

  gets(movie_name);
  gets(movie_type);
}
```

A)
```
#include<iostream.h>
#include<stdio.h>
void main( )
{
 struct movie
 {
  char movie_name[20];
  char movie_type;
  int ticket_cost;
 }Movie;
Movie.ticket_cost=100;
gets(Movie.movie_name);
cin>>Movie.movie_type;
}
```

c. **Define the terms Polymorphism & Inheritance.**   **2**

d.Write the output of the following program.   3

```
#include <iostream.h>
void main()
{
   int x = 5;
   if(x++ = = 5)
     cout<<‖five‖<<endl;
   else
```

```
        if(++x = = 6)
          cout<<‖Six‖<<endl;
}
```

e)
What will be the output of the following segment?   4

```
struct number
{
   int no1, no2;
};

void display(number n)
{
   cout<<‖Number1=‖<<n.no1++<<‖Number2=‖<<- -n.no2<<endl;
}
void main( )
{
   number n1={10,100}, n2, n3;
   n3 = n1;
   n1.no1 + = 5;
   n2 = n3;
   n2.no1 - = 5;
   n2.no2 * = 2;
   n3.no1 + = 1;
   display(n1);
   display(n2);
   display(n3);
}
```

f. convert $(4A8c)_{16}$ into binary number   2

Q.No.5

a. Write a program to find the factorial of any given number   3

b. Assuming suitable data types give necessary declaration for an array of 20 voter records each record of which consists of four data values viz. id_no,name, address, age, make use of above declaration to write program segment that print id_no and name for all those whose age exceeds 60.   5

c. Write a program to add two matrices of same order MXN.   4

d. Write a program to find either given no is prime or not   3

e. Write a function to find simple interest   3

Sample Paper -V
Subject – Computer Science

Time: 3Hours

Maximum Marks: 70

Note. (i) All questions are compulsory.

Q.No.1
a. Write the header file for the given function   2
   abs(), isdigit(), sqrt(), setw()
b. Define Microcomputer   1
c. what is data and what is the output of data processing system   2
d. what is the function of memory and what are its measuring units   2
e. what do you mean by language processor.   2
f. what is the difference between save and save as command.   2
g. Expand the following: 2
   i)CPU ii) ROM iii)MICR iv)CD-R 2

Q.No.2

a. Rewrite the following code after removing the syntax error if any. Underline the correction   2
```
#include <iostream.h>
jampto(int, int )
void main()
{
     first=10, second=20;
     jumpto(first;second);
     jumpto(second);
}
void jumpto(int n1, intn2=20)
{
  n1=n1+n2;
}
```

(b) Find the output :   3
```
void result(int &x, int y=10)
{
   int temp = x +
   y; x + = temp;
   if(y <=10)
      y + = temp;
}
void main( )
{
   int A1=10, B2=5;
   result(A1, B2);
   cout<<A1<<B2<<endl;
   result(A1);
   cout<<A1<<B2<<endl;
   result(B2);
   cout<<A1<<B2<<endl;
}
```

D. Find the output   3

```cpp
 #include <iostream.h>
void main( )
{
   int i = 0, x =
  0; do
  {
    if(i % 5 = = 0)
    { cout<<x;
    x++;
    }
    ++ i;
  }while(i<10);
  cout<<‖\n‖<<x;
}
```

e. Find the correct possible output   3

```cpp
    void main()
    {
      randomize();
      char city[][10]={―del‖,‖chn‖,‖kol‖,‖bom‖,‖bng‖};
      int fly ;
      for(int i=0;i<3;i++)
      {
        fly = random(2)+1;
        cout<<city[fly]<<‖:‖
      }
    }
```
 Output:-
 1.   Del:chn;kol
 2.   Chn:kol:chn
 3.   Kol:bom:bng
 4.   Kol:chn:kol

Q.No.3

a. what do you mean by literals? What are the different kind of literals   3
b. Explain the types of errors in c++   2
c. what is the difference between structure and arrays   2
d. what do you mean by dynamic and static allocation   3
e. what is the difference between _a' and ―a‖ in c++.   1
f. What do you mean by code generation   2

Q.No.4

a. What do you mean by nested structure? Explain with suitable example   2
b. What is data abstraction? Explain the concept with the help of an example.
c. Convert the following equations to C++ statements.   3
        i) s = 1+1/x+1/x2+1/x3
         A) s = 1 + 1/x + 1/(x*x) + 1/(x*x*x);
        ii) V = 4/3∏r3
     A) V = 4/(3*3.1415*r*r*r);
d. Explain any two string handling functions with syntax and examples   3

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e. i)$(AC.20)_{16}$= $(?)_2$= $(?)_8$ ii) $(4A56)_{16}$= $(?)_{10}$= $(?)_8$

f. Find the 1's and 2's complement of 128.   3

g. explain a nested for with suitable example   2

Q.No.4

a. Write a program to print the diagonal (left & right) elements of an N☐N matrix.   4

A)
//Program to print the left and right diagonal element of an NXN matrix

```cpp
#include<iostream.h>
#include<conio.h>
#include<iomanip.h>
void main( )
{
  int A[10][10];
  int i,j,N;
  clrscr( );
  cout<<"\nHow many rows and columns required for matrix: ";
  cin>>N;
  cout<<"\nEnter "<<N*N<<" elements: ";
  for(i=0;i<N;i++)
  {
     cout<<"Enter the elements into Row "<<i+1<<": ";
     for(j=0;j<N;j++)
      cin>>A[i][j];
  }
  clrscr( );
  cout<<"\nThe entered elements in the matrix are: \n";
  for(i=0;i<N;i++)
  {
     for(j=0;j<N;j++)
       cout<<A[i][j]<<"\t";
       cout<<endl;
  }
  cout<<"\n\n\nThe elements which are belongs to only diagonals...\n";
  for(i=0;i<N;i++)
 {
  for(j=0;j<N;j++)
  if((i==j)||((i+j)==(N-1)))
   cout<<setw(6)<<A[i][j];
  else
   cout<<" ";
   cout<<endl;
 }
getch( );
}
```

 b. Write a program to find the factorial of a number recursive function.   4

A)

```cpp
#include<iostream.h>
#include<conio.h>
```

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```
long f =1;
long factorial(int n)
{
  if (n==0)
    return f;
  else
  f=n*factorial(n-1);
}
void main( )
{
  clrscr( );
  long num;
  cout<<"\nEnter the number to which you want to find factorial: ";
  cin>>num;
  cout<<"\nThe factorial of the number = "<<factorial(num);
  getch( );
}
```

c. **3.**Write a program to find the total number of characters, lines and words in a
paragraph of text.   4

A)
```
#include<iostream.h>
#include<conio.h>
#include<stdio.h>
void main( )
{
 char str[300];
 int i,charcount=0,words=1,lines=1;
 clrscr();
 cout<<"\nEnter the Paragraph ie message: \n";
 gets(str);
 for(i=0;str[i]!='\0';i++)
  {
    charcount++;
    if(str[i]==' ')
      words++;
    if (charcount%80==0)
      lines++;
  }
 cout<<"\nNumber of Characters in the entered message: "<<charcount;
 cout<<"\nNumber of Words in the entered message: "<<words;
 cout<<"\nNumber of Lines in the entered message: "<<lines;
 getch( );
}
```

d.Write a program to sort an array on N numbers in ascending order. Avoid
duplication of elements.   4

A)
```
#include<iostream.h>
#include<conio.h>
void main( )
{
 clrscr( );
```

```cpp
    int A[20],N,i,j,temp;
    cout<<‖\nEnter the number of
    elements:‖; cin>>N;
    for(i=0;i<N;i++)
      cin>>A[i];
    //Bubble sort technique
     for(i=0;i<N;++i)
       for(j=0;j<(N-1)-i
         ;j++) if(A[j]>A[j+1])
           { Temp=A[j];
              A[j]=A[j+1];
              A[j+1]=Temp;
           }
   cout<<"The Elements in the array after sorting…. ";
   for(i=0;i<N;i++)
   cout<<A[i]<<'\t';
}
```

e..Write a program to find the roots of a quadratic equation.   2

A) #include<iostream.h>

```cpp
#include<conio.h>
#include<math.h>
void main( )
{
  clrscr( );
  double d1,d2,b,a,c,d;
  cout<<"\nEnter the value of b,a and c:
  "; cin>>b>>a>>c;
  d=(b*b-sqrt(4*a*c));
  if(d==0)
    cout<<"\nRoots are equal or distinct";
  else if(d>=0)
   cout<<"\nRoots are
  Real"; else
   cout<<"\nRoots are complex..ie Imaginary";
  d1=(-b+d)/(2*a);
  d2=(b+d)/(2*a);
  cout<<"\nD1: "<<d1;
  cout<<"\nD2: "<<d2;
  getch( );
}
```