Paintings, graphics, and photographs lend colour and beauty to walls, advertisements, magazines, and publications. But which is the best out of many, and why, is often determined based on mathematical calculations.

In fact, art and mathematics have always shared a long and close relationship. The ancient Egyptians and Greeks knew about the golden ratio, regarded as an aesthetically pleasing ratio, and incorporated it into the design of monuments including the Great Pyramid, the Parthenon, the Colosseum. Many artists have been known to have been inspired by mathematics and studied mathematics as a means of complementing their works.

Mathematical tools have always been used in the creation of art. Since ancient times, mathematical tools have combined with the imagination of the artist to create beautiful designs realized in the architecture and decoration of palaces, cathedrals, temples, and mosques. The

Do art and mathematics go together? Unseen mathematical calculations and patterns balance work of art and help in rhythmic movements to make it look attractive. And artistic presentation allows mathematical information to take on a visual shape.

Mathematics in Art?
Greek sculptor Polykleitos prescribed a series of mathematical proportions for carving the ideal male nude. In fact, our most universal standard of measurement is the human body. We judge the appropriateness of size of objects by that measure. To lend balance to a piece of art the artist often tries to position the image at the optical center, which may not necessarily be the mathematical centre. A correct center may be very important for architectural designs but it may not be the same in visual art like paintings etc. If the center is drawn or the subject is placed in the exact center, the created art may look immature.

To make a shape or image look right in the given area, it requires to be balanced with space around it. But putting the shape in the exact center of the given space will not give the best result. The reason: the human eye doesn’t see a mathematically perfect center as correct. Instead, it will give an illusion as if the shape is set low or out of balance and the work of art – whether a painting, a page layout or an advertisement loses the ‘wow’ factor.

Hence, the shape needs to be drawn or placed optically centered to make it look correct and balanced. The optical center is always the place just above the centre of any space/area. Any shape, element placed on the optical center gives the feel of a correct center and thus looks balanced. It is not only this center but also many more facts that determine the aesthetic value of any work of art or design.

The Optical Center

The human brain is used to view things the way nature has created. The best example is the shape of the human face and body. If we try to find out or analyze the center point of the human body, we see optically the center of the body in the center of the torso. This is a very important part of the body where the heart and lungs are placed – both the organs are very vital for human life.

Optical center is a position slightly higher in the given space or a page than the true center line. However, it must remain an equal distance from the left and
right. There is a simple calculation to find out the optical center. First, measure the top-to-bottom height and width of the paper/canvas/space. Divide this height and width into half and draw lines. Divide the top half into ten parts. Depending upon the shape and size of the item/element to be drawn, the optical center can be anywhere between $1/10$ – $5/10$ of the distance of half the page above the true center point created by crossing the vertical and horizontal line in the beginning.

Art of Balancing through Calculations

Visual art in any form has to look balanced for it to interest the reader or viewer and look attractive. In science, balance is the concept of visual equilibrium that relates to our physical sense of balance. Any good artistic composition can achieve balance in one of two ways: symmetrically or asymmetrically. The reconciliation results in visual stability. An artist, painter or sculptor can balance while visualizing or drawing a work of art with various designing elements like shapes, space and colours, apart from the main subject.

It is like walking. When a man puts a foot forward to take a step, the entire body gets into motion: one arm goes backwards, the other forward and simultaneously the other foot gets ready to take yet another step. The same is the case with art, the moment one item is shifted or drawn the rest also needs to take a position to maintain the rhythm and balance in the painting.

The art of calculation of balancing is much more required when the work of art has more than one component, like in the case of painting a landscape. The objective is to create a balanced composition of all the items of the landscape. There are various ways. For

<table>
<thead>
<tr>
<th>Principles of Good Composition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Balance</td>
</tr>
<tr>
<td>Proportion</td>
</tr>
<tr>
<td>Rhythm</td>
</tr>
<tr>
<td>Emphasis</td>
</tr>
<tr>
<td>Unity</td>
</tr>
</tbody>
</table>

Monalisa is a beautiful painting and researchers and art critics have studied it in numerous ways. The painting is found to be balanced in easyway - optical center, colour depth as well as in rhythm.

**Optical Center:** The main part of the painting, the face is falling on the optical center, besides, the correct center of the face, the center of the nose, is on the optical center of the complete painting.

**Balance:** The painting is almost divided in two through colour depths as shown by drawn ellipses.

**Rhythm:** Look into her eyes, then come down the angle of her left hand, the viewer’s eyes then take a loop along her right hand and come upwards.

'David' famous statue by Michelangelo has the beauty through the perfect match of optical center, balance and rhythm. While whole weight of the body is on one leg (shown in dark magenta) the movement of rhythm downwards (shown in blue curves) is balanced by a small upward action/curve (shown in magenta curve) that takes the viewers eyes to the attractive face of statue.
instance, if there is a large component in the subject, it will always come near the center of the space/canvas. This large component can be balanced very well with a small sharp component near the opposite corner. When there are two equally important components, they can come together or even overlap each other.

Role of White or Blank Space

In art, white space is not to be considered merely ‘blank’ space – it is an important element of design that enables the objects in it to exist in balance. There has to be a balance between the positive, the subject (image), and the use of negative space with only some colour, colour strokes, non-important elements related with the main subject like clouds, curtains, birds etc. in the background.

However, these elements are not painted to the extent of hundred percent finishing. These small elements help create excellent painting/design/layout/illustration which are the keys to aesthetic composition. The appropriate use of the negative space not only gives balance to the positive space (actual image) in a composition but is also considered by many as good design as it gives breathing space. When it breathes, it is alive, as with any living organism. This basic and often overlooked principle of design gives the eye a “place to rest,” increasing the appeal of a composition through subtle means.

The Rhythm

Rhythm is the term given to the movement of eyes within the area of composition or painting. It is a kind of scale to measure the quality of any work of art. Just as living beings are fascinated by the good rhythmic notes of music, similarly good rhythm in the painting gives aesthetic pleasure to the viewer.

When any item is drawn, placed or added in the given space, the brain of a good designer automatically adjusts the rest of the shapes and images, keeping intact the importance of the main subject. Just as the human brain helps balance the human body by appropriate movement/action of the body without falling, in the same manner the brain also guides the designer/artist. A good artist can exactly visualize the contents of the painting or work of art first in the mind and then on paper/canvas or stone.

The fundamental of any composition is that the total impact of the visual should be composed and compact. There should be some rhythm in the placed components. Colours and even brush strokes help in creating the rhythm in the work of art, which helps in making a painting or art piece look balanced. With this characteristic, the viewer’s eyes move within the area of the painting making it look more attractive.

Ms Neeru Sharma is the Graphic Designer of Science Reporter and is also Principal Technical Officer at NISCAIR, CSIR.