SNS COLLEGE OF ENGINEERING

Kurumbapalayam(Po), Coimbatore – 641 107
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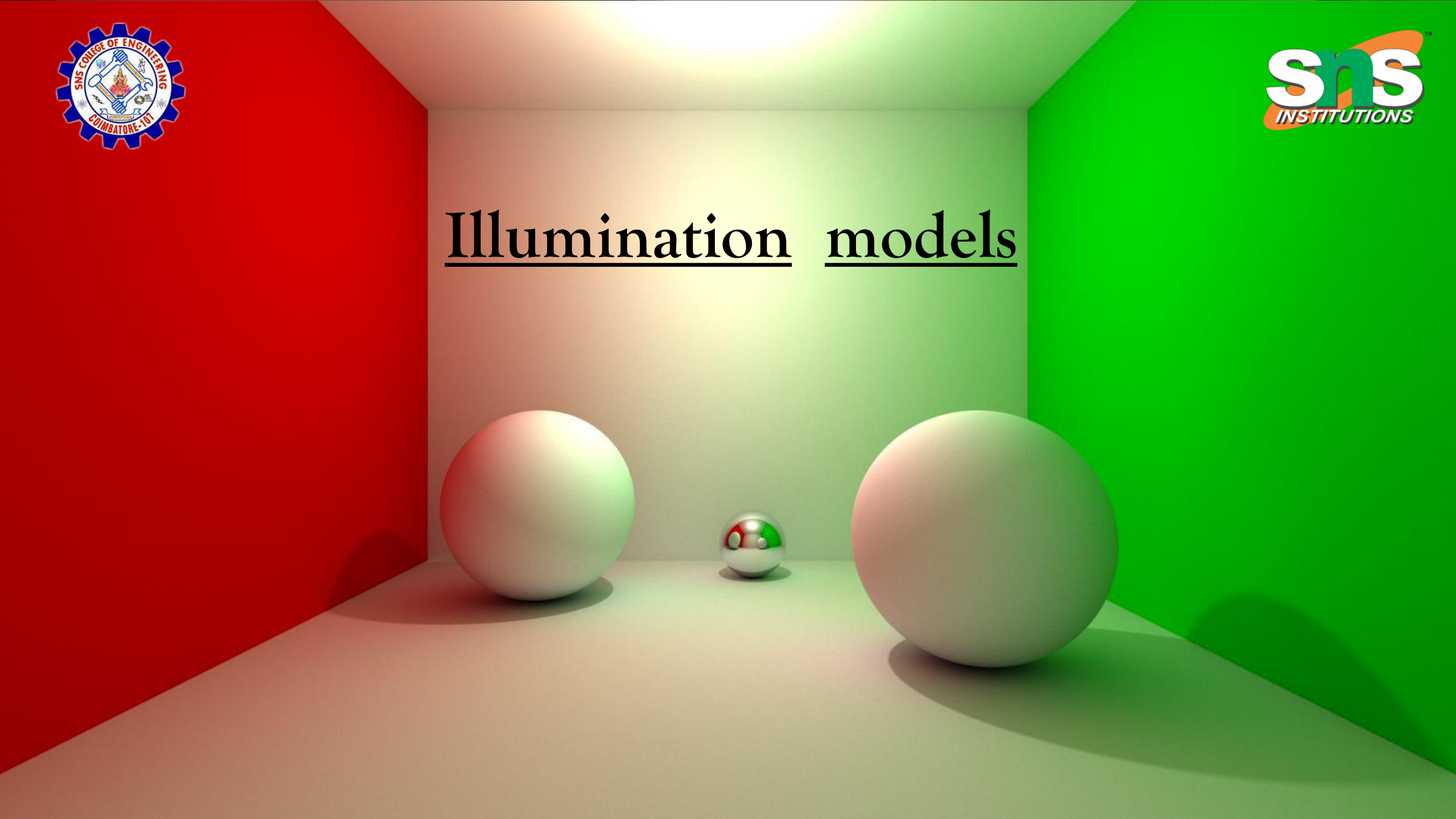
Department of Information Technology & Artificial Intelligence & DataScience

Course Name – COMPUTER GRAPHICS

III Year / V Semester

Unit 3 : VIEWING AND VISUAL REALISM

Topic : – ILLUMINATION MODELS


Illumination models

Illumination models

- **Illumination model**, also known as Shading model or Lightning model, is used to calculate the intensity of light that is reflected at a given point on surface. There are three factors on which lightning effect depends on:
- Light Source
- Surface
- Observer

Light Source

- Light source is the light emitting source. There are three types of light sources:

1. **Point Sources** – The source that emit rays in all directions (A bulb in a room).
2. **Parallel Sources** – Can be considered as a point source which is far from the surface (The sun).
3. **Distributed Sources** – Rays originate from a finite area (A tubelight).

Surface

- When light falls on a surface part of it is reflected and part of it is absorbed.
- Now the surface structure decides the amount of reflection and absorption of light.
- The position of the surface and positions of all the nearby surfaces also determine the lightning effect.

Observer

- The observer's position and sensor spectrum sensitivities also affect the lightning effect.

Ambdient Illumination

- Assume you are standing on a road, facing a building with glass exterior and sun rays are falling on that building reflecting back from it and the falling on the object under observation. This would be **Ambient Illumination**. In simple words, Ambient Illumination is the one where source of light is indirect.
- The reflected intensity I_{amb} of any point on the surface is:

$$I_{amb} = K_a I_a$$

Where, I_a : ambient light intensity
K_a : surface ambient reflectivity, value of K_a varies from 0 to 1

Diffuse Reflection

- Diffuse reflection occurs on the surfaces which are rough or grainy. In this reflection the brightness of a point depends upon the angle made by the light source and the surface.
- The reflected intensity I_{diff} of a point on the surface is:

$$I_{diff} = K_d I_p \cos(\theta) = K_d I_p (N \cdot L)$$

Where, I_p : the point light intensity
K_d : the surface diffuse reflectivity, value of K_d varies from 0 to 1
N : the surface normal
L : the light direction

Specular Reflection

- When light falls on any shiny or glossy surface most of it is reflected back, such reflection is known as Specular Reflection.
- **Phong Model** is an empirical model for Specular Reflection which provides us with the formula for calculation the reflected intensity I_{spec}:

$$I_{spec} = W(\theta)\, I_l \cos^n(\Phi)$$

where, $W(\theta)$: K_s

L : direction of light source

N : normal to the surface

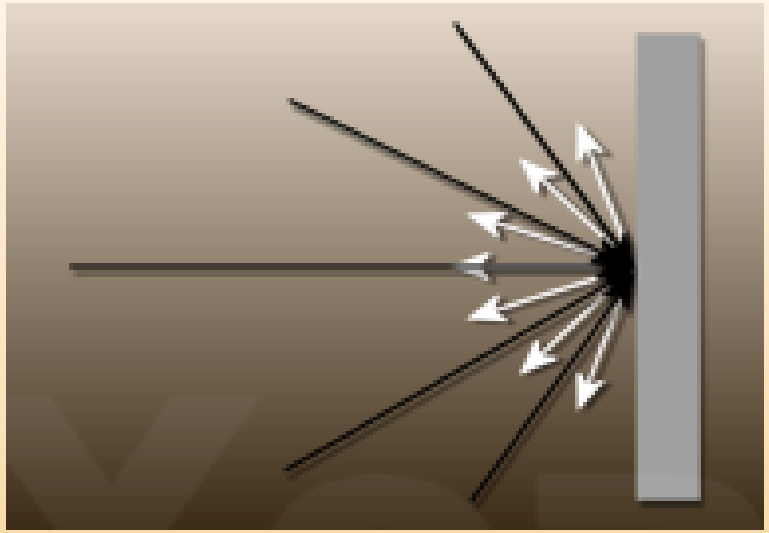
R : direction of reflected ray

V : direction of observer

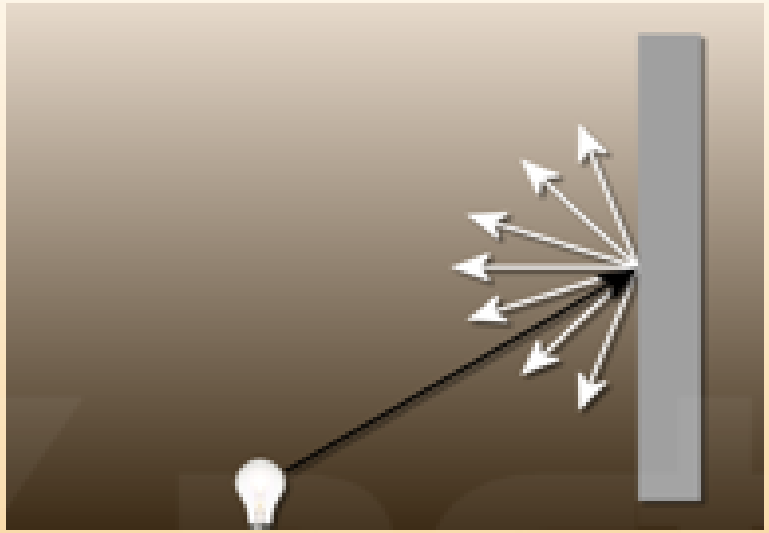
Θ : Angle between L and R

Φ : angle between R and V

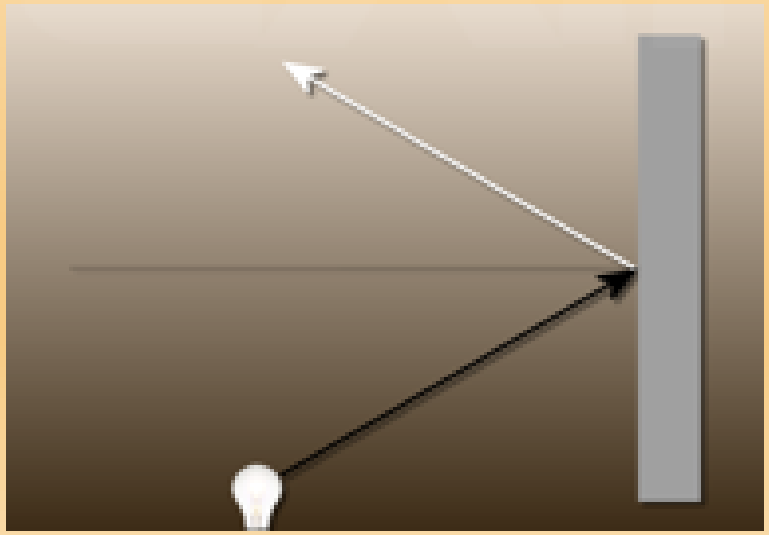
Ambient



Diffuse



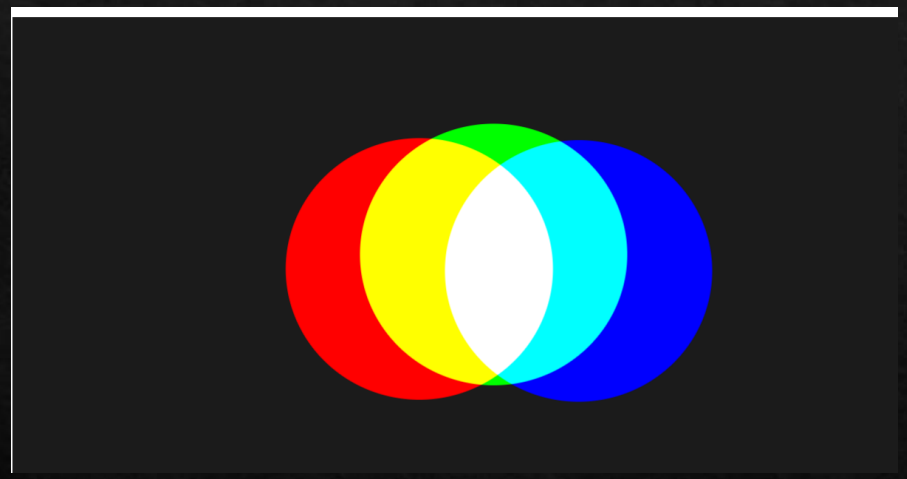
Specular



Color Models

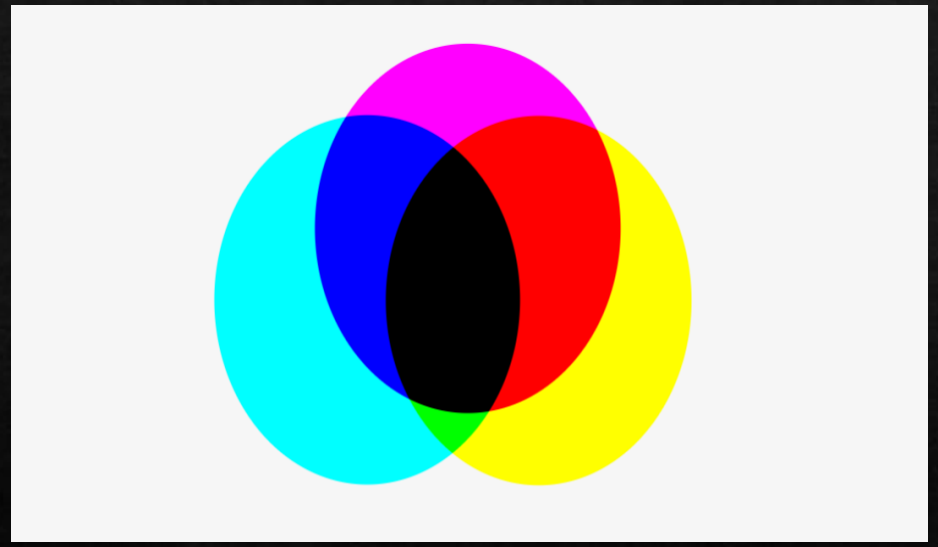
- A color model is a way to describe colors in a color system. Most color models have 3 dimensions, such as the best known: RGB. From Red, Green and Blue. And because of the three dimensions, a color system can be represented with 3 axes, so in 3D.
- You could say that all models ultimately all come out at RGB. But usually we do not distinguish one, but two main color models, which are also the best known; RGB and CMY. These color models can be further subdivided into sub-color models.
- It is of Two Types:
- **Additive color mixing and light**
- **Subtractive color mixing and paint**

Additive color mixing and light



- Light is thus perceived by the R, G and B cones and brightness rods in our eyes. Ultimately, everything we call color is in fact just light. Different colored light rays can be mixed together by overlapping each other. Just think of two spots where the rays intersect. This method of color mixing is called additive, because colored lights that overlap/mix are added together and we then observe the result of that addition with our eyes.
- The basic colors for additive color mixing are normally red, green and blue. Just like the cones in our eyes. Red, green and blue are therefore the primary colors for additive color mixing, or light mixing.

Subtractive color mixing and paint



- A child quickly understands that if you mix yellow paint with cyan paint (a child could call it light blue) you get green. Yellow paint absorbs from the incoming white light all the blue light rays and the cyan paint absorbs all the red rays from the light, so we perceive green.
- For everything that is not light itself, but filters light and reflects, so for example ink and paint, the primary colors are Cyan, Magenta and Yellow (CMY). When blending paint or ink, it doesn't add up as with mixing light, but it's subtracted from each other. That is why we call this subtractive mixing.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THANK YOU....