



# FOSSEE Summer Fellowship 2022

On

## Graphics and Animation in blender 3.0.1

Submitted by

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Under the guidance of

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# Acknowledgement

I would like to express my gratitude to **Prof. Kannan M.Moudalya** whose vision of fossee has enabled me to work on such a creative endeavor, of using, learning and teaching the use of open source applications to those who need it.

I would like to thank my mentor **Mr. Khushalsingh K . Rajput, SPSE (Graphics and Animation)**, whose contribution in stimulating suggestions, guidance and encouragement, helped me to coordinate my project with a good workflow.

With Regards,

**Sunil Bairwa**

# Content

# Introduction

1. **Objective-**

   The Objective of this fellowship is to create educational 3D animation videos for students. These videos should be clear and short which can relay the topic as easily as possible.

   The primary objective was to create the videos but in the process of it I made 3D models with textures extensively in blender. So the side goal is to introduce blender to the people who are interested in 3D and get them started by providing them with free 3D models, textures etc.

2. **Blender**

   Blender is a free and open-source 3D computer graphics software toolset used for creating animated films, visual effects, art, 3D printed models, interactive 3D applications and video games. Blender's features include 3D modeling, UV unwrapping, texturing, raster graphics editing, rigging and skinning, fluid and smoke simulation, particle simulation, soft body simulation, sculpting, animating, match moving, rendering, motion graphics, video editing and compositing.

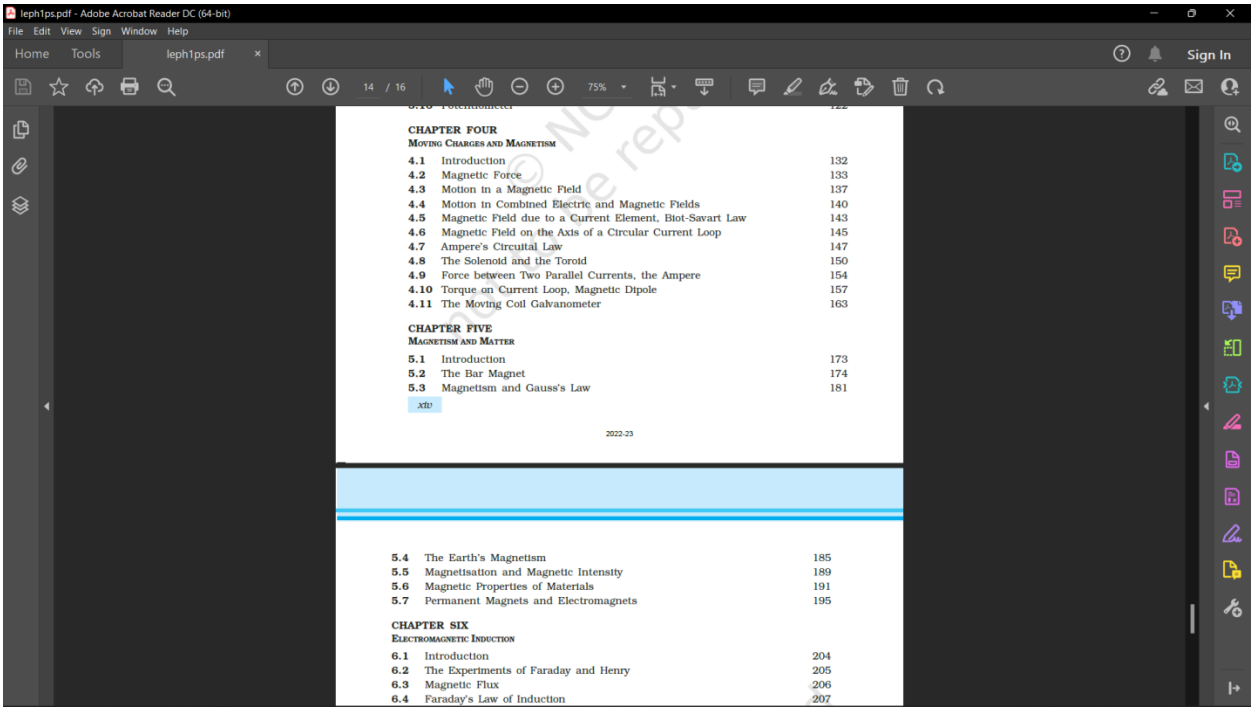
   For this project I was using Blender 2.82 version. I used Eevee for the rendering process.

# Project Workflow

1. **Selecting topics for animations**-

For creating animations the topic should be something which needs 3D visualizations to be understood clearly and which can be compressed in 2 minutes video without creating any confusion.

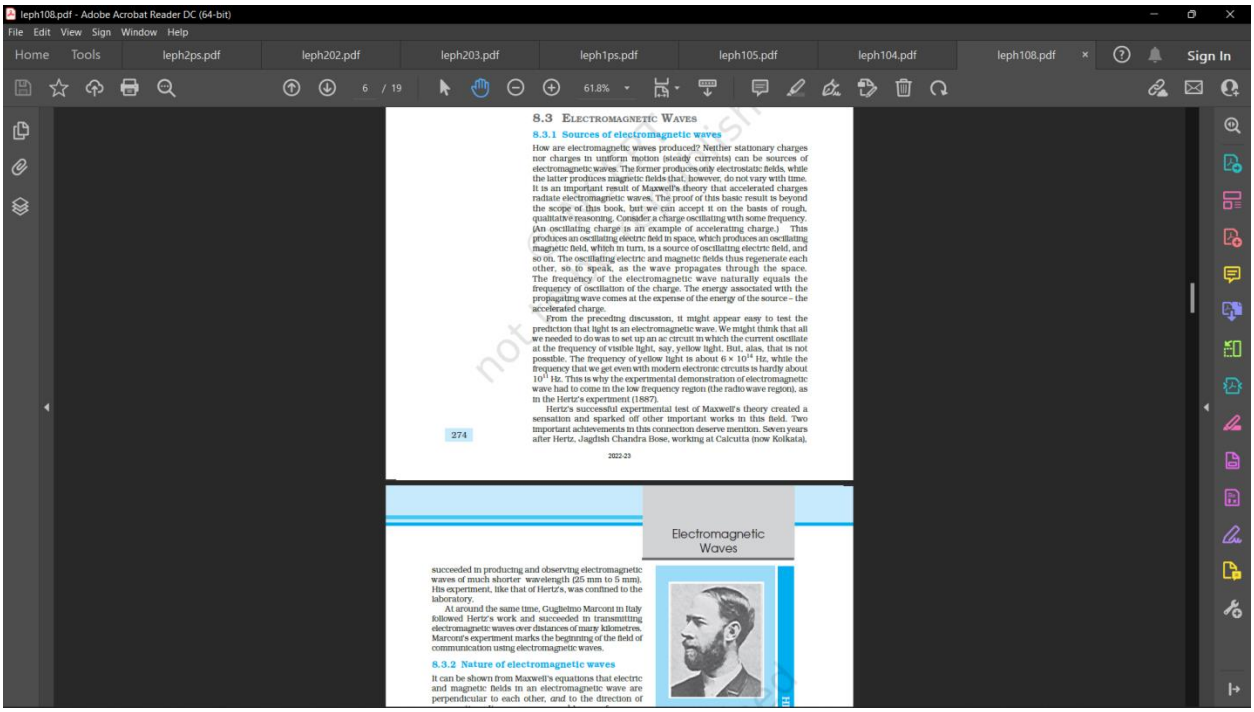
I selected 4 topics for animations, Earth magnetism, electromagnetic waves, electromagnetic spectrum and electron emission/photoelectric effect.

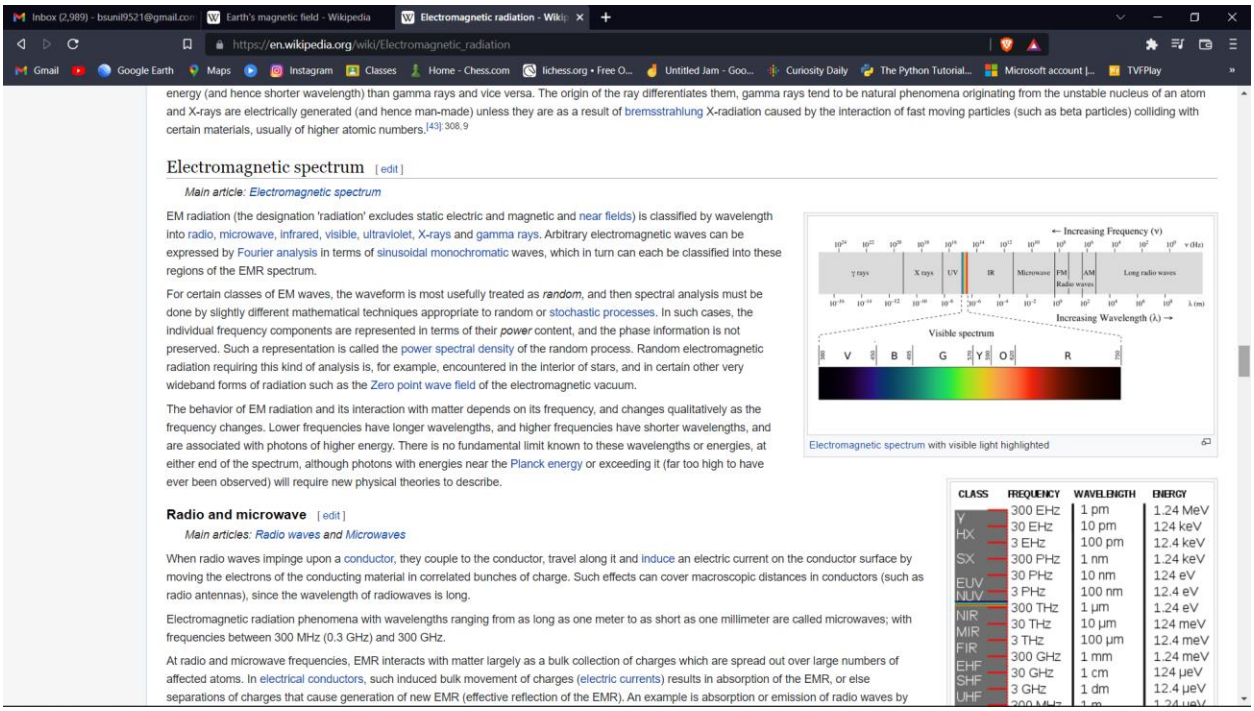


## 2. Researching for the topics-

To start working on the video we need to do some research on the topic for a good understanding of it. When we have a good understanding of the topic we can convey it more efficiently. And it's important for making a good script for the video.

I researched the topics primarily from class 12th physics NCERT book. Its explanations are precise and short which is great for a video and for details I went to Wikipedia pages of the topics.

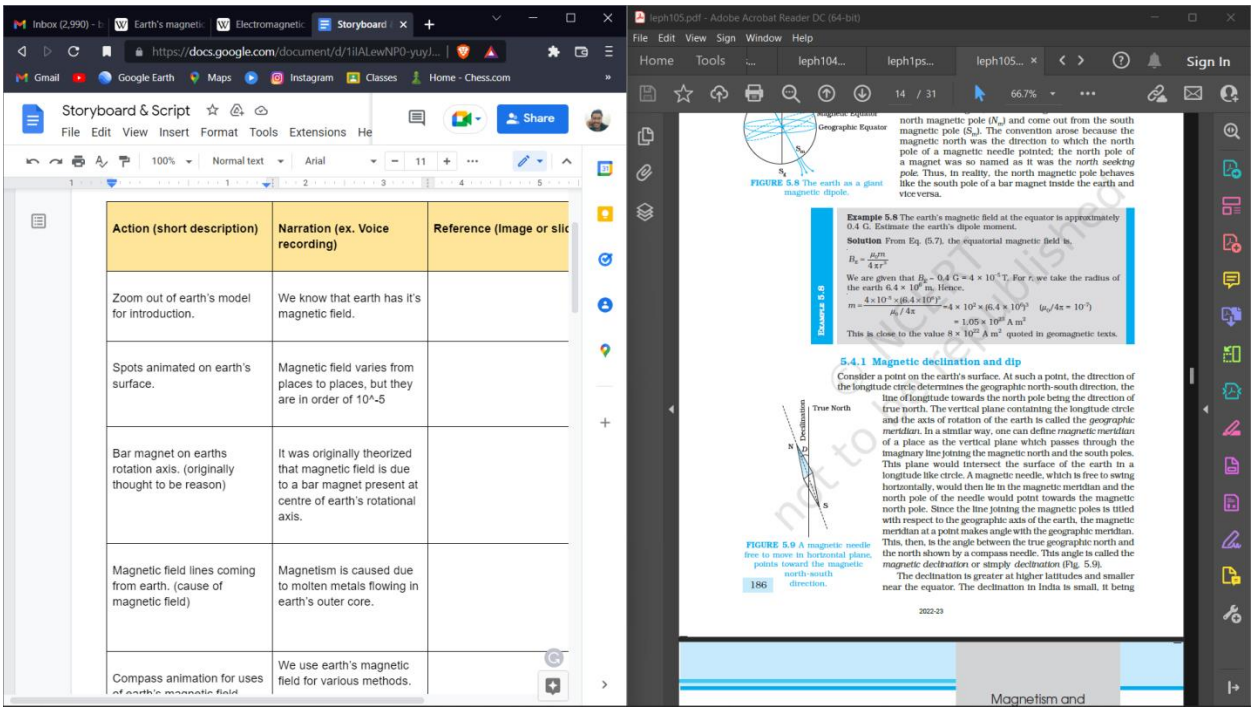





## 3. Scripting-

Scripting is a very important part for making an animation video. It's important for the content and sequencing of the things to explain in a video. The narration for the video also gets very easy later when the scripting is already done.

I did the scripting from the data I collected from ncert book and Wikipedia.



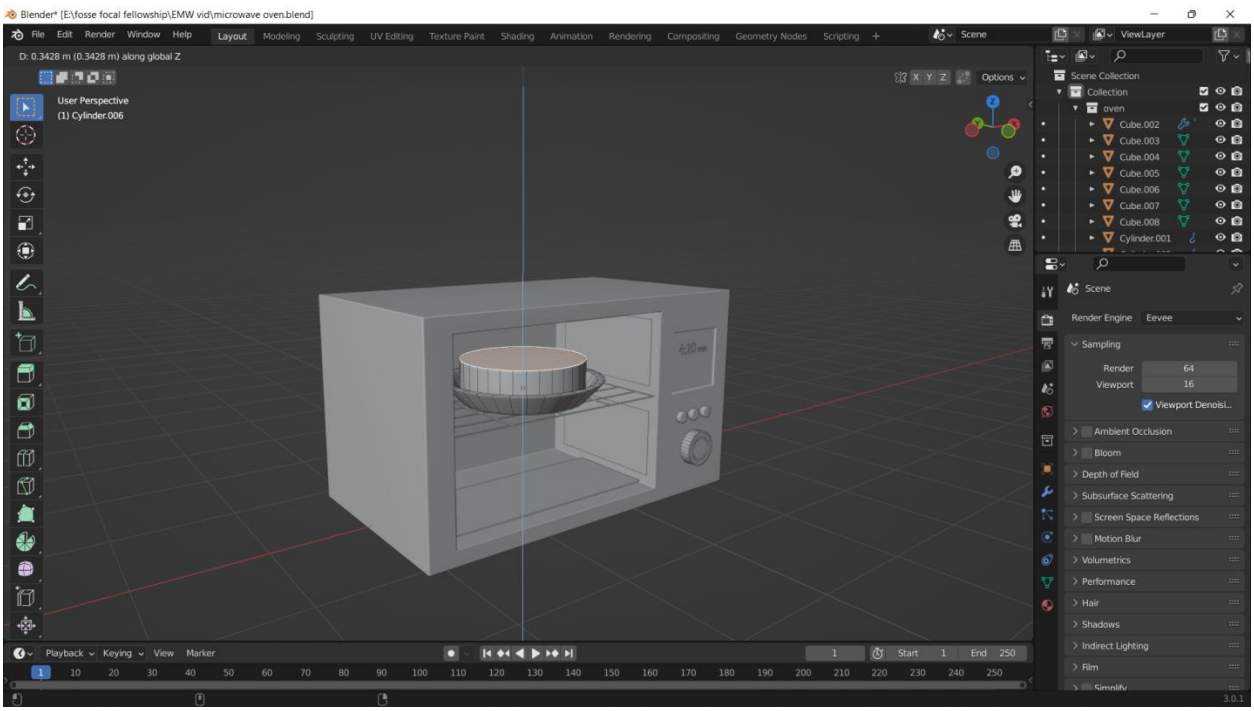
Storyboard & Script

| Action (short description) | Narration (ex. Voice recording) | Reference (Image or slic |
|---|---|---|
| Zoom out of earth's model for introduction. | We know that earth has it's magnetic field. | |
| Spots animated on earth's surface. | Magnetic field varies from places to places, but they are in order of 10^-5 | |
| Bar magnet on earths rotation axis. (originally thought to be reason) | It was originally theorized that magnetic field is due to a bar magnet present at centre of earth's rotational axis. | |
| Magnetic field lines coming from earth. (cause of magnetic field) | Magnetism is caused due to molten metals flowing in earth's outer core. | |
| Compass animation for uses of earth's magnetic field | We use earth's magnetic field for various methods. | |



## 4. 3D modeling-

We use blender for 3D model the props used in the animations.
I make a separate blend file for the assets used in each video, and I can append them later in the animation file. If there are multiple objects in a single prop I can move them to a new collection so it will be easy to append and animate them later.
I made models like Satellite, Microwave, TV remote, Earth, Compass, Radar, and some small models.

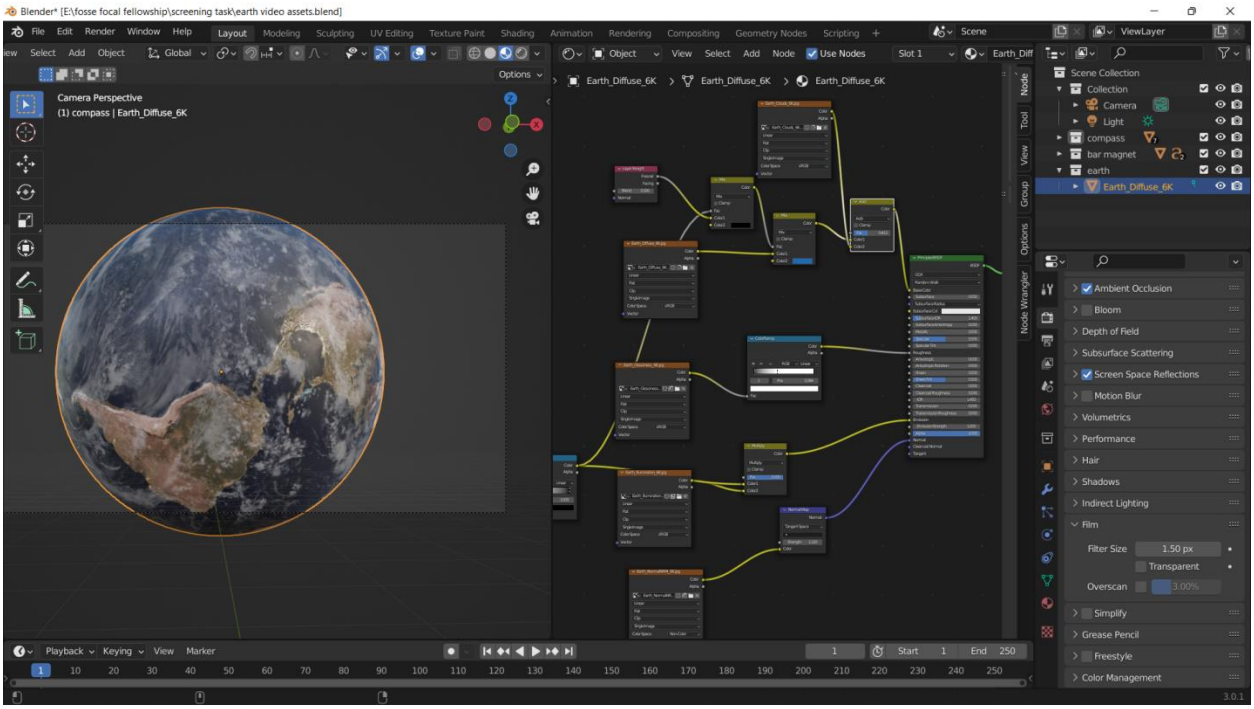


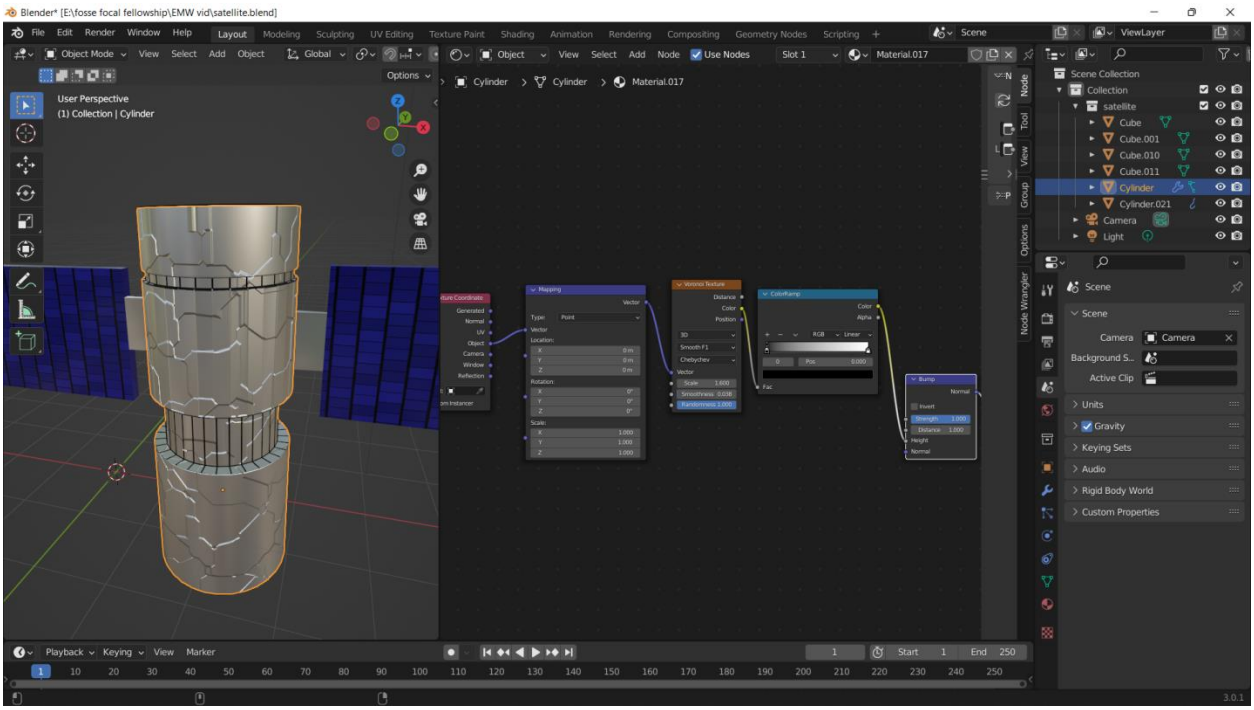

## 5. Texturing-

After modeling texturing gives a model more detail and life. There are different ways to texture a model in blender using free pbr textures from internet or using image textures by unwrapping the models or by procedural nodes.

I made all the textures in blender using procedural nodes as I can change or modify them easily. I used noise texture, brick texture, wave texture, voronoi texture or image texture for making them.

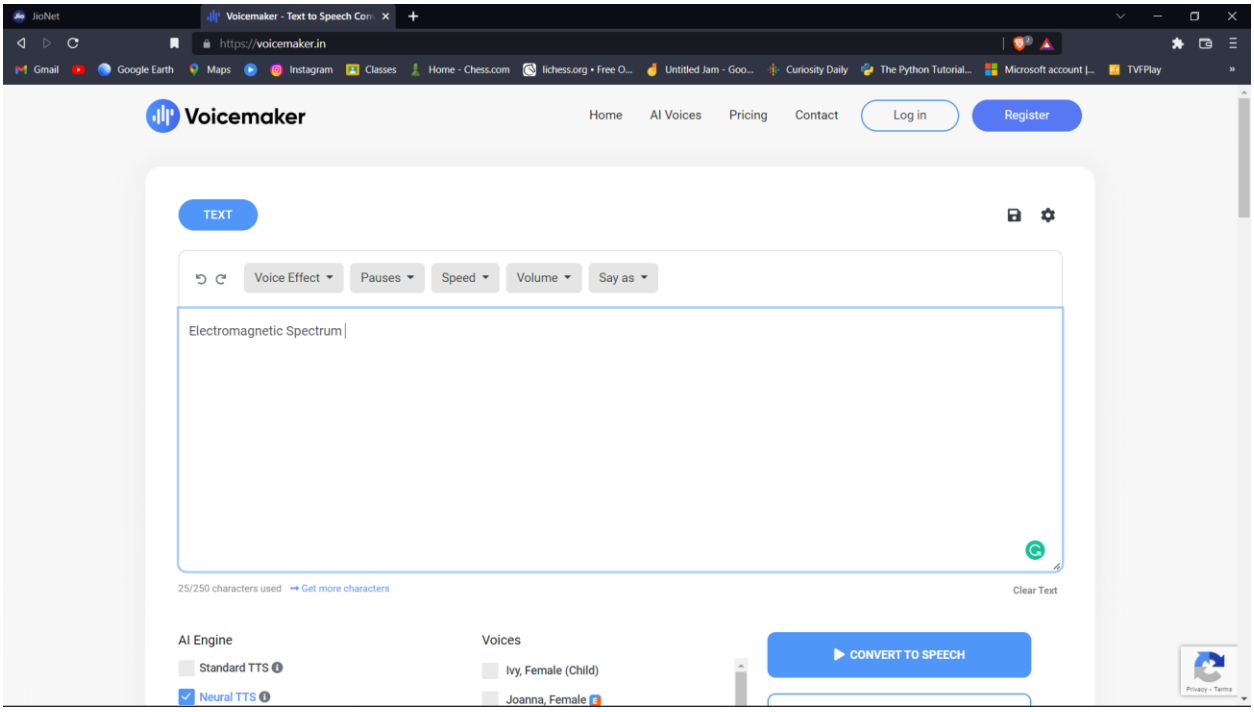
We can experiment by combining them with each other for an unique texture.





## 6. Narration-

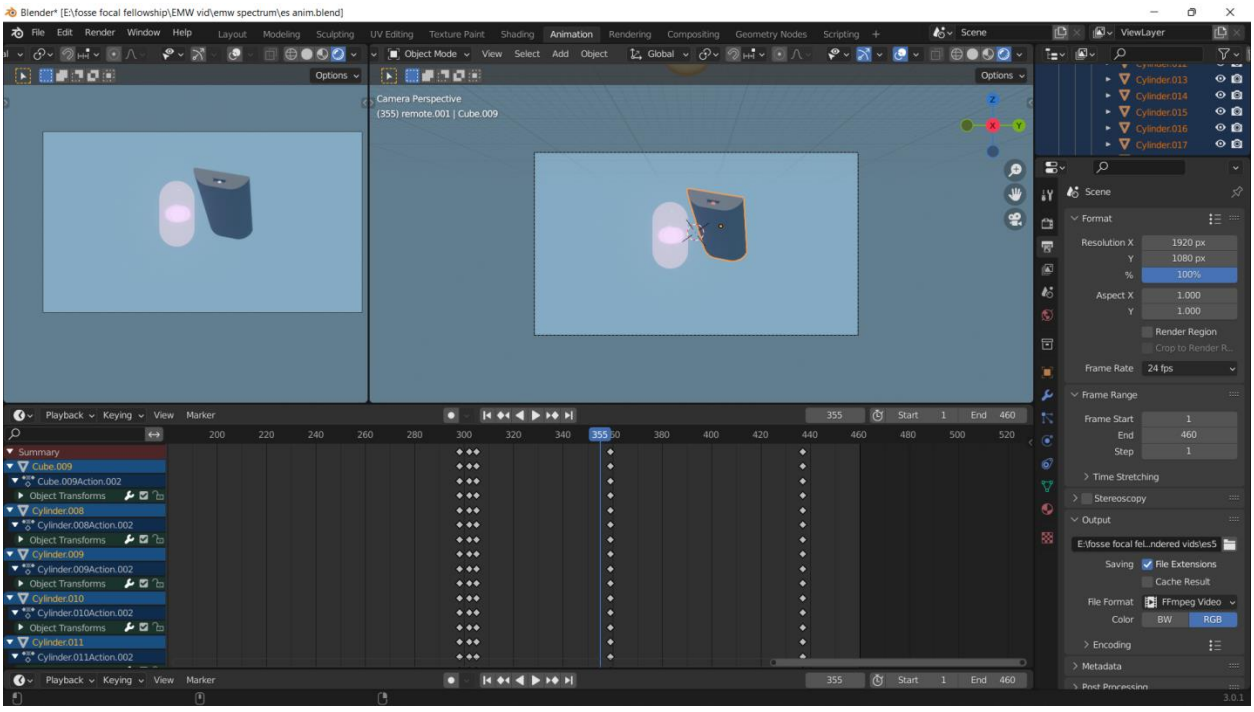
For the narration we already have a script we can narrate it by ourselves if you have a good microphone, or as I did it by using a free website for text to speech narration using AI. It did a good job of replicating human speech and it felt less computerized and clear.

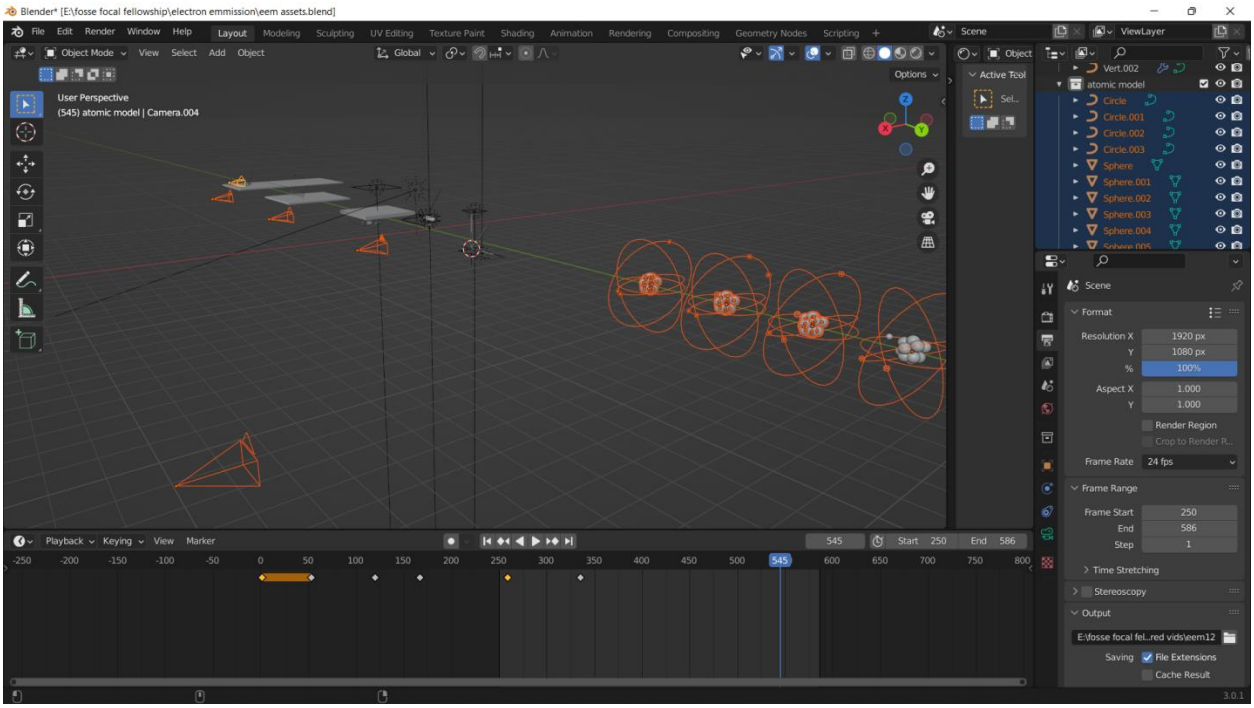


## 7. Animating-

After narration next step is to animate the models and environment according to the script and time frame. I keep in mind the narration lines so it will be easy ahead to mix audio and video later.

I animated different sections with different cameras for each different dialogue in narration. This method made animation more easy and organized. I can change a section of the video without disturbing other sections.

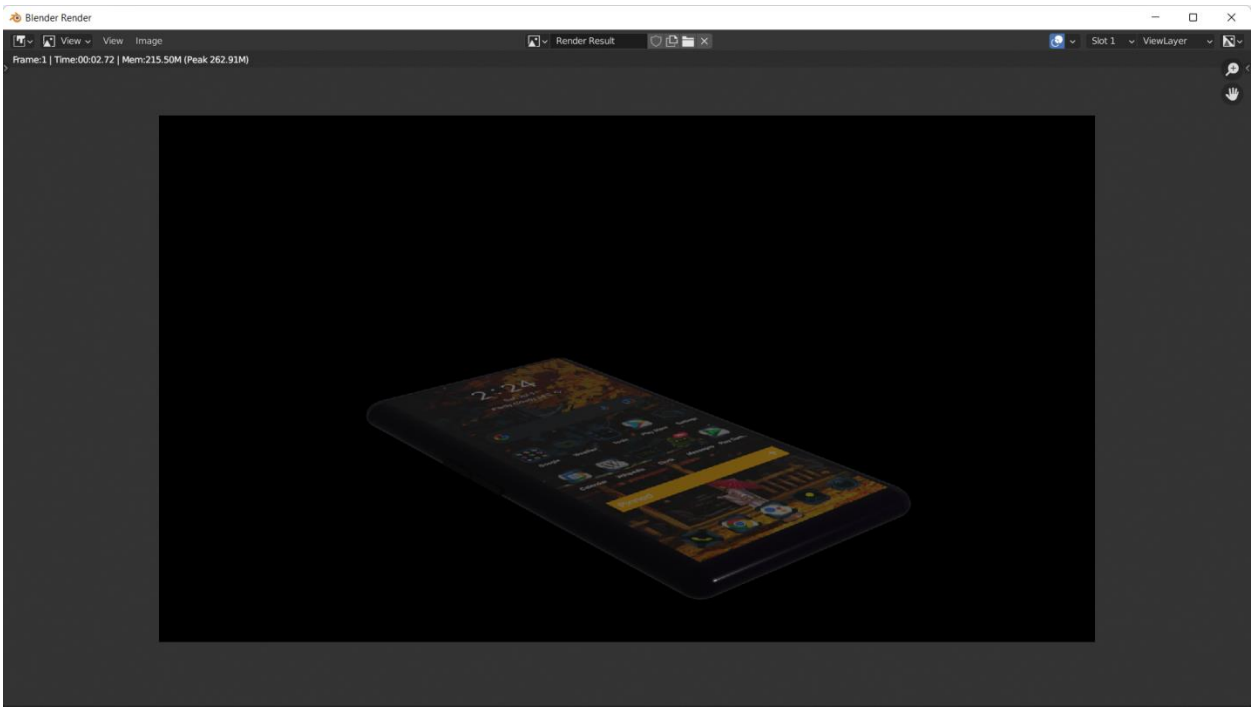





## 8. Rendering-

After animating we have to render the animation. There are two main engines for rendering in Blender eevee and cycles. Eevee is easy on your hardware and take less time than cycles but it compromises on the quality of render in shadows and lighting data. Cycles render the scene more realistically but it takes a toll on your hardware and takes much more time. To reduce the time for renders we can use sheepit render farm which uses community hardware for rendering and it renders faster than normal render time.

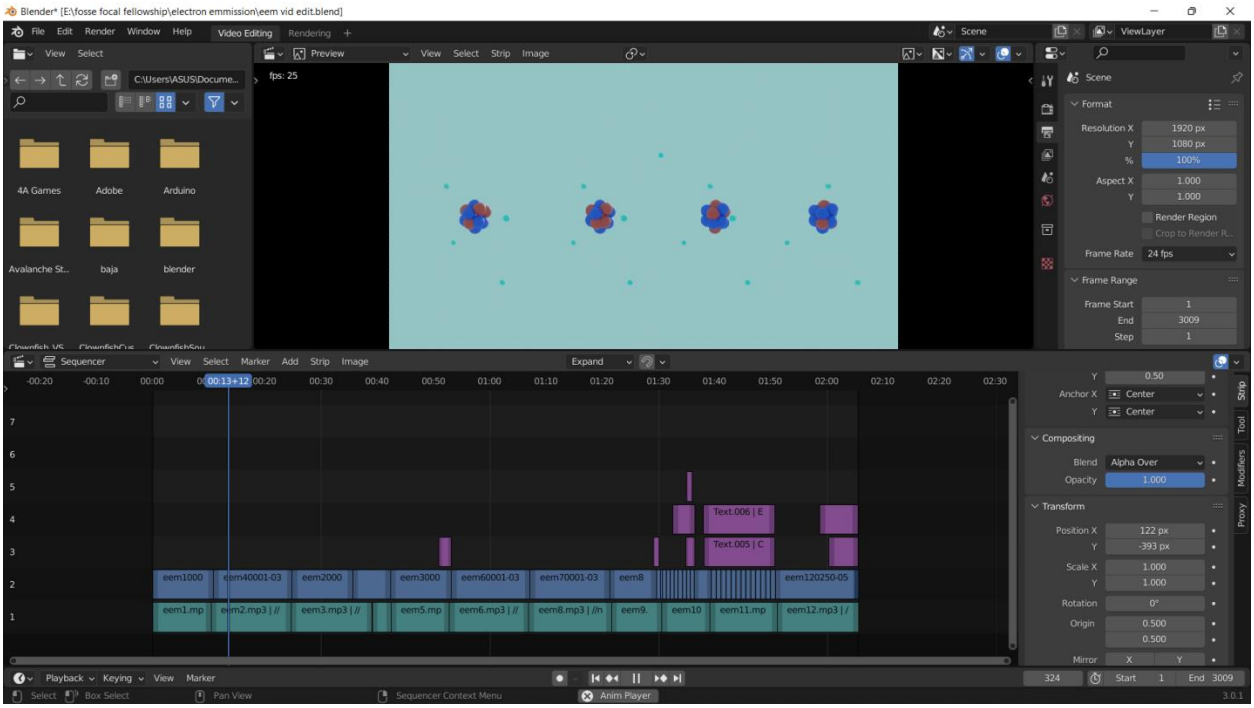
I used eevee render engine for my videos, as my animations are not on realism side of animation.




## 9. Editing-

After rendering the videos it's time to mix the audio and video files and add some text. I used blender inbuilt video editor.
As my audio and video files were of same length they were easy to align. I added text which were important for understanding.

I added some background music too. In blender video editor we can add different effects to video and audio files.




## 10. Final Output-

For the final output of the video I chose mp4 file format. My videos are average 2 minutes long. So in mp4 format they are not very big in size and are easier to transfer.

# Video Description-

1. **Earth magnetism-**

   The video starts with the range of magnitude of earth's magnetic field and how it's different in different places.

   Then it goes on to how we used to think that the magnetic field is due to something like a bar magnet but it is because of molten iron and other metals flowing at core of the earth.

   It tells about how magnetic axis doesn't align with rotation axis and is at an angle of 11.3 degrees. And reason for some important nomenclature.

   Different Meridians and nomenclature related to it.

2. **Electromagnetic waves-**

   At the start of the video it tells us about the sources of the electric field, magnetic field and electromagnetic field.

   How the electromagnetic field is composed of electric field and magnetic field and their perpendicular orientation.
   Equations of electromagnetic field, maxwell's equations and relation between electric and magnetic field.

   Speed of emw waves and concept of energy and momentum in emw waves. And use of emw waves.

3. **Electromagnetic spectrum-**

   The video shows the distinction and nomenclature of different waves at different frequencies.

   I showed sources and applications of these frequencies using models and animations and frequency data is also provided.

4. **Electron emission**-

   This video has properties of electron and atoms on a metallic surface and different ways of removing electrons from the atoms. First is thermionic emission, then high field emission and third one is photoelectric emission.

   Photoelectric emission animation shows how monochromatic light is used to emit electrons from the metallic surface, its experimental setup and effect of intensity of light on photoelectric current.

## Issue faced and solution-

The primary issue faced by me was coming with a good script which should be short as well as communicating the message as easily as possible. But it was solved by doing enough research about the topic and rejecting less important topics which were making the videos longer.

## References-

1. NCERT Books
2. Wikipedia pages

## Software used-

1. Blender 3.0.1
2. Google storyboard and script

## Open Source websites-

1. VoiceMaker - Free Text to Speech Converter
2. youtube free audio library

Thank you.