Electromagnetism
Dr. Nirmal Ganguli
Department of Physics
Indian Institute of Science Education and Research, Bhopal

Lecture – 52
Parallel plate capacitors

Let us consider another example and that is about Parallel plate capacitors.

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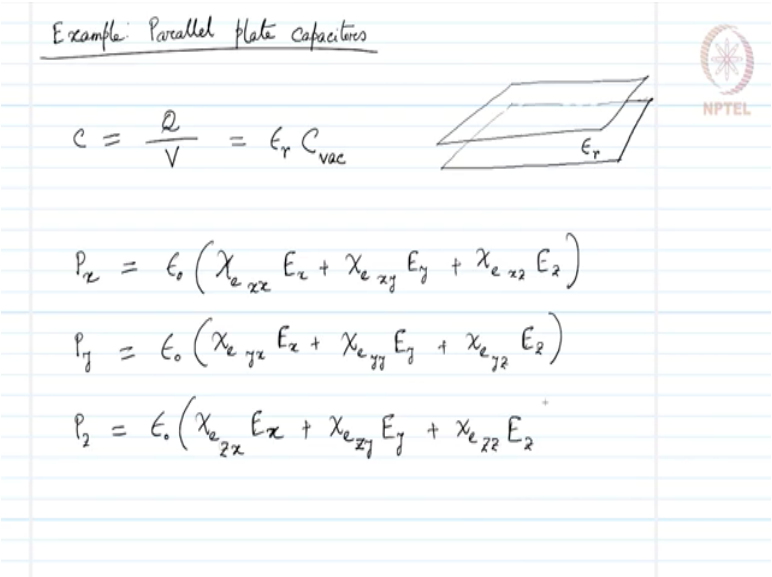

So, in order to increase the capacitance of a parallel plate capacitor; it is a good idea to fill the separation between two parallel plates with a dielectric material. Because as a response to the electric field develop inside, the dielectric material will develop a polarisation and in turn the potential difference for a given amount of charge will decrease, with that the capacitance of that capacitor will increase.

Once that happens, that is helpful for practical purposes and that is why it is good idea to fill the space between two plates with a dielectric material. Let us assume we have a parallel plate capacitor where the region between two plates has been filled with dielectric material. So, here is one plate, here is another plate like this and in between that we have a material with epsilon r as the relative permittivity.

And the electric field is confined to the space between the planes and it is not outside. So, we will have with this dielectric filling the capacitance that is equals total charge on each plate over the potential difference that is developed and that means; this will become epsilon r times the capacitance if there was vacuum in between these two plates.

That means; we are increasing the capacitance of this parallel plate capacitor by putting a dielectric material in between. Now if the dielectric material were not linear; if we had a non-linear dielectric material, then what kind of susceptibility did we have and what kind of situation could we expect. Then with a dielectric material where epsilon sorry, where the susceptibility is not a scaler and it is in generally a tenser we can write down as a function as a response of the electric field, the polarisation would look something like this. P x is epsilon not chi electric x x, E x plus chi e xy, E y plus chi e xz, E z. Similarly, P y can be written as and P z can be written as sorry, this could be zx.