Advanced Microwave Guided-Structures and Analysis
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Lecture No. 25
Radiation from an Electric Current Source Tutorials

Hello every1, let us solve some few more numerical problems on relation between wave numbers.

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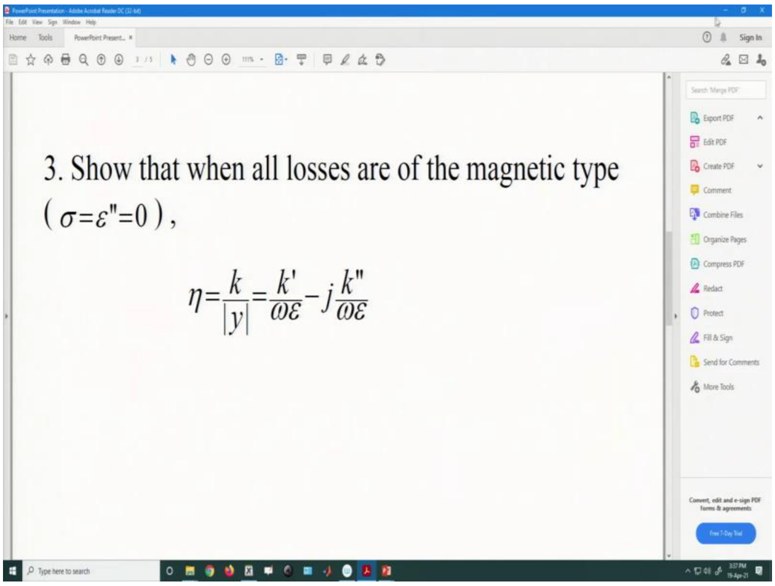
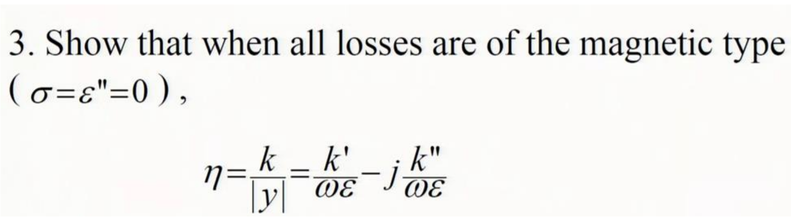


So, to start with the first problem states that



So, let us start solving this.

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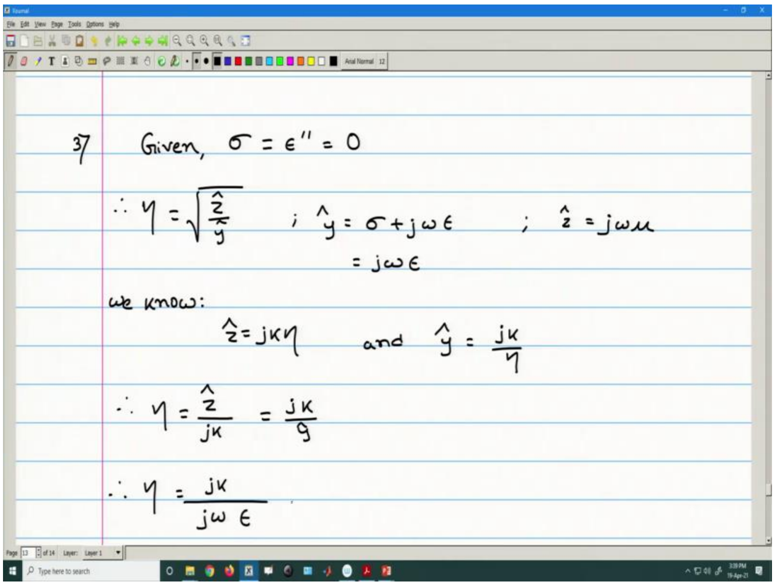

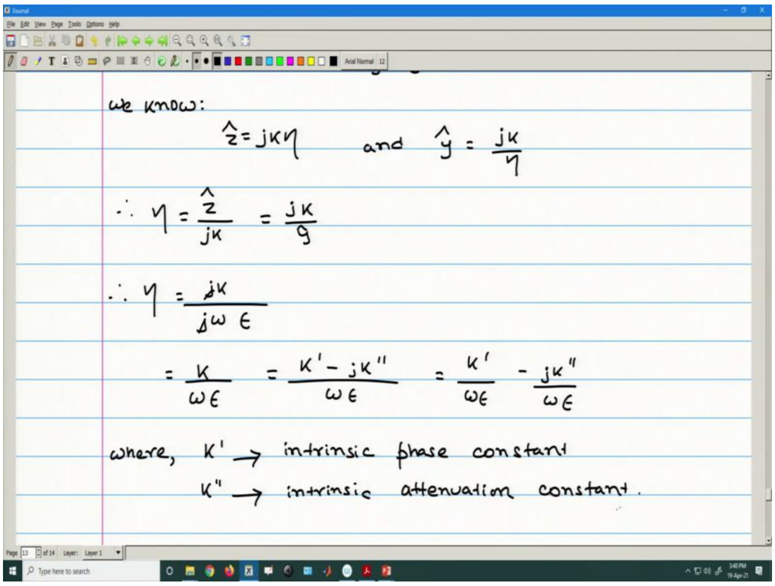

So, we are given that

37 Given, $\sigma = \epsilon'' = 0$

$$\therefore \eta = \sqrt{\frac{\hat{z}}{\hat{y}}} \quad ; \quad \hat{y} = \sigma + j\omega\epsilon \quad ; \quad \hat{z} = j\omega\mu$$

$$= j\omega\epsilon$$

we know:

$$\hat{z} = jK\eta \quad \text{and} \quad \hat{y} = \frac{jK}{\eta}$$

$$\therefore \eta = \frac{\hat{z}}{jK} = \frac{jK}{\hat{y}}$$

$$\therefore \eta = \frac{jK}{j\omega\epsilon}$$

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$$\therefore \eta = \frac{jK}{j\omega\epsilon}$$

$$= \frac{K}{\omega\epsilon} = \frac{K' - jK''}{\omega\epsilon} = \frac{K'}{\omega\epsilon} - \frac{jK''}{\omega\epsilon}$$

where, $K' \rightarrow$ intrinsic phase constant

$K'' \rightarrow$ intrinsic attenuation constant.

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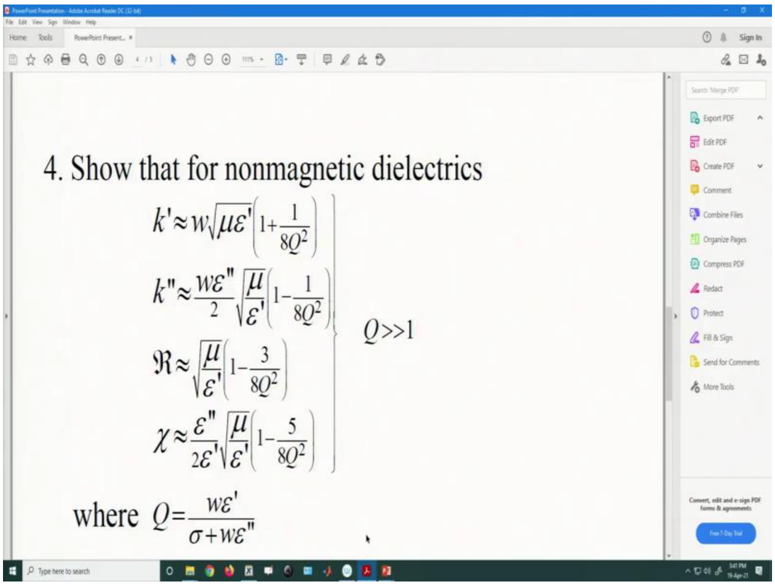
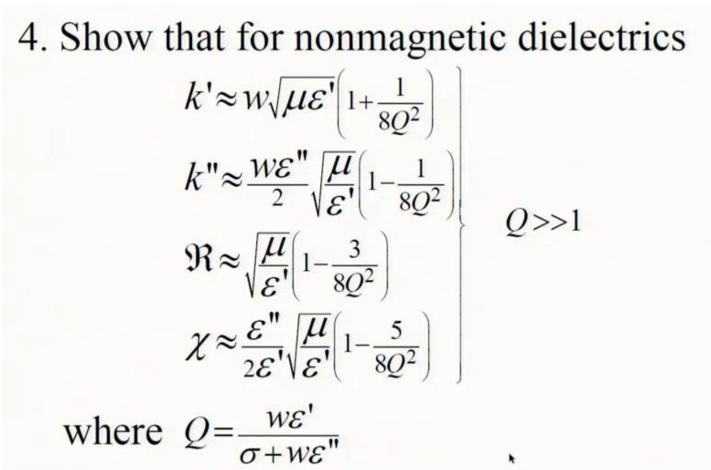


The next problem is that



So again, we will start solving.

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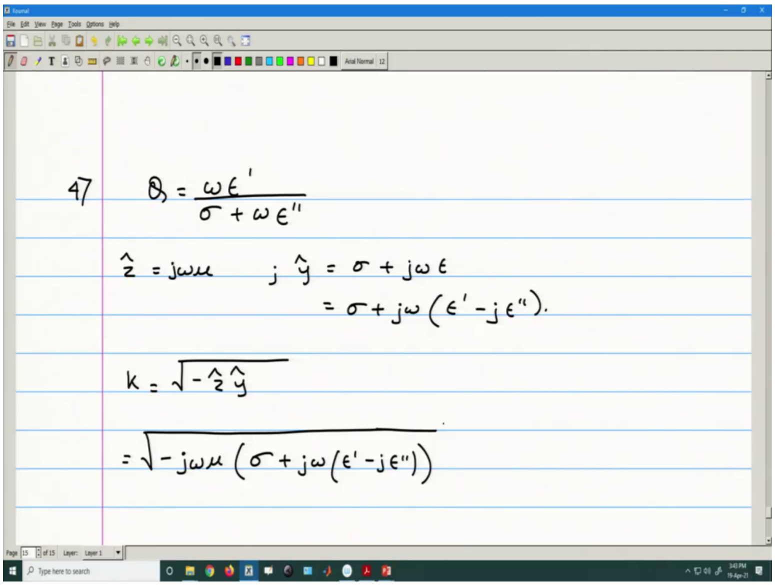
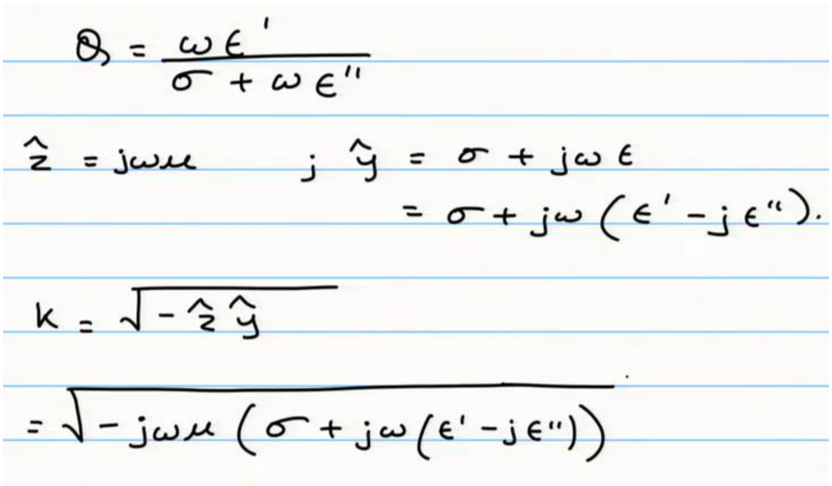


So, we it is given that quality factor is written as



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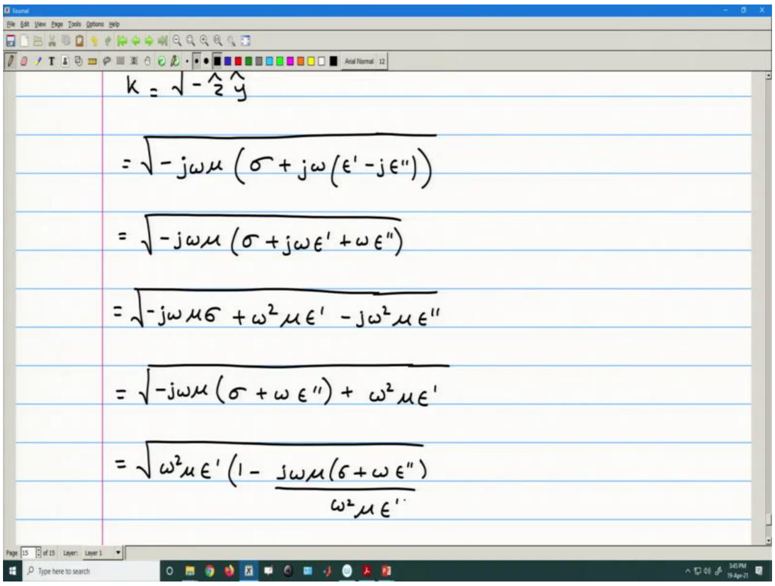
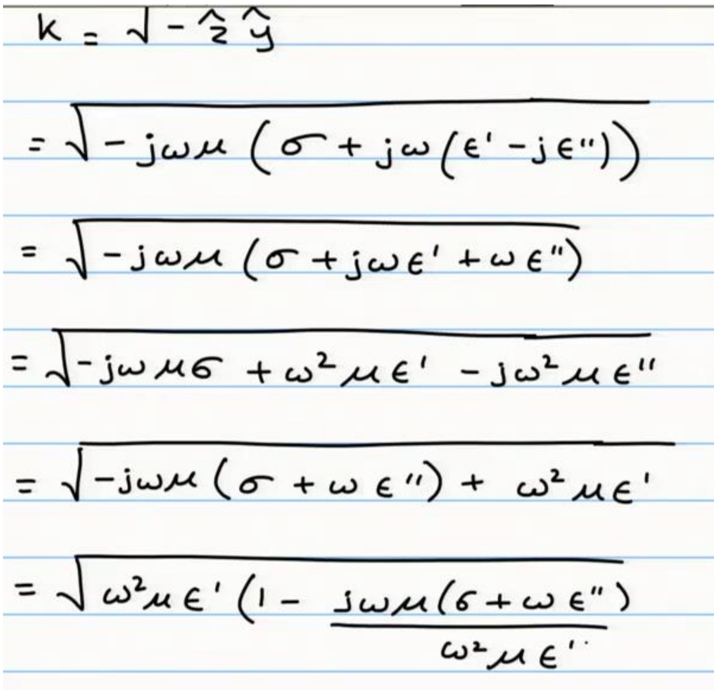


Now, we will simplify this just open up the braces, we will get



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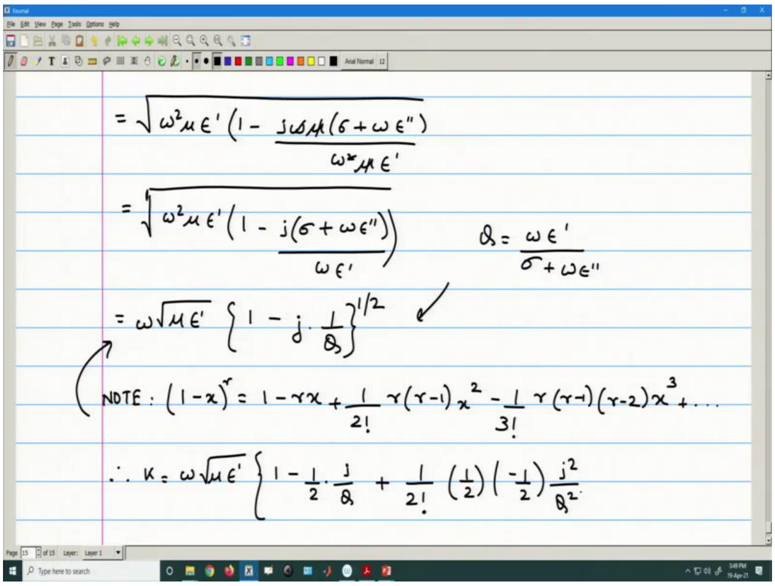
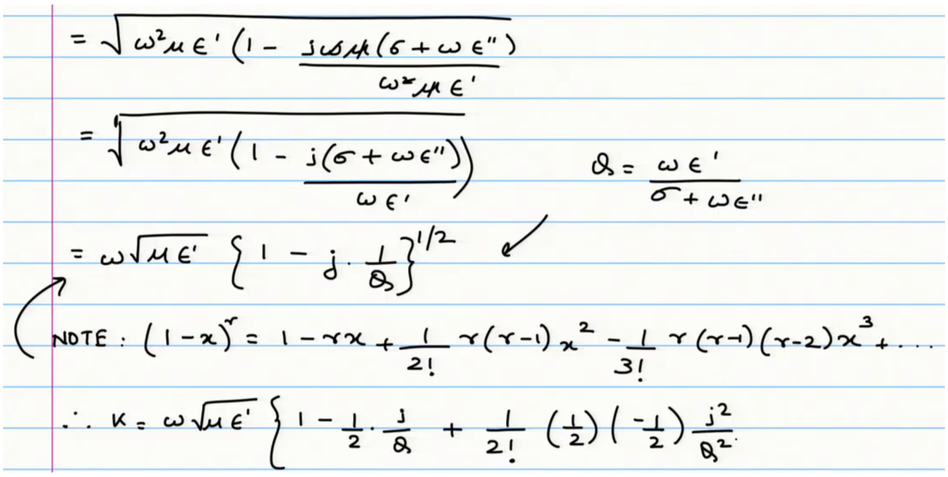
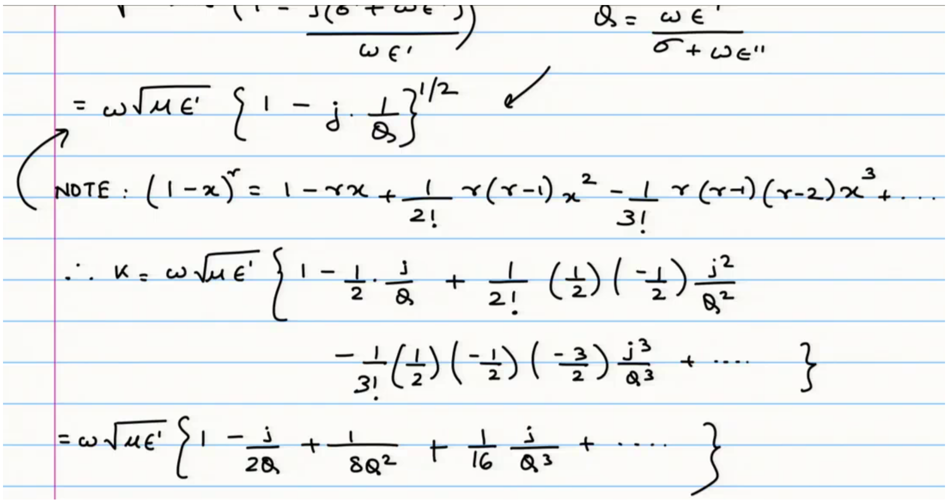


Then we can write this





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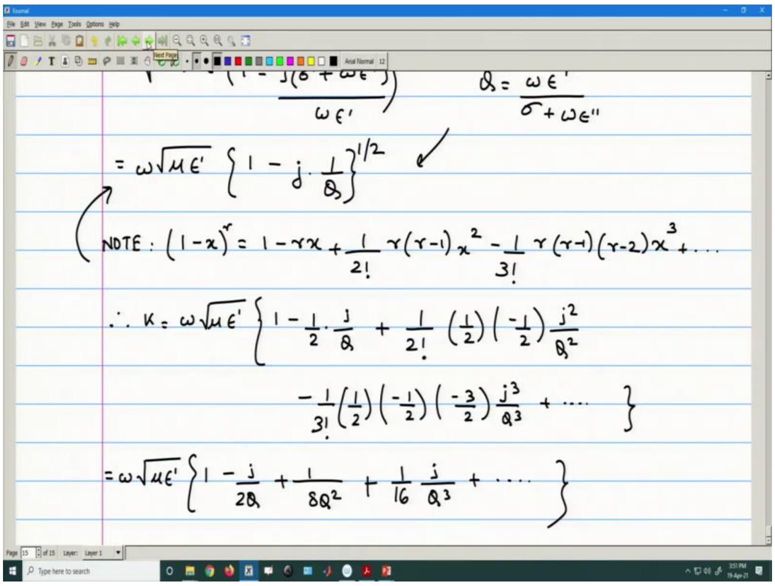

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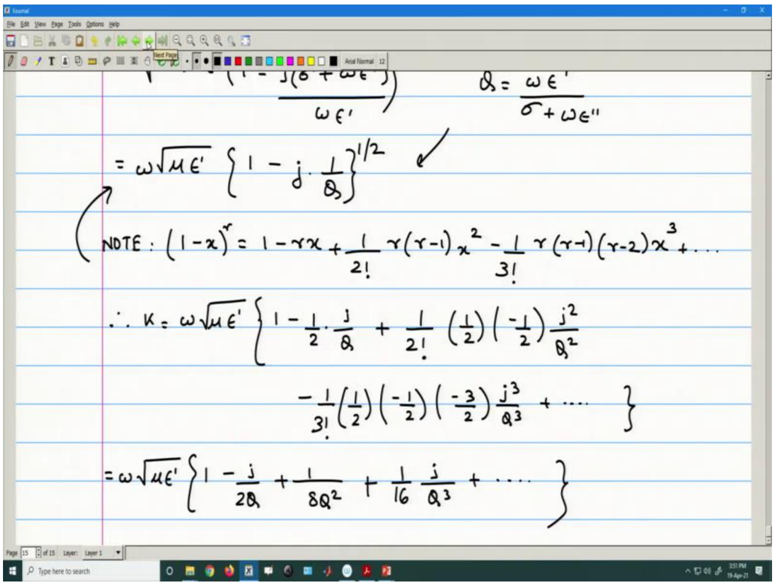
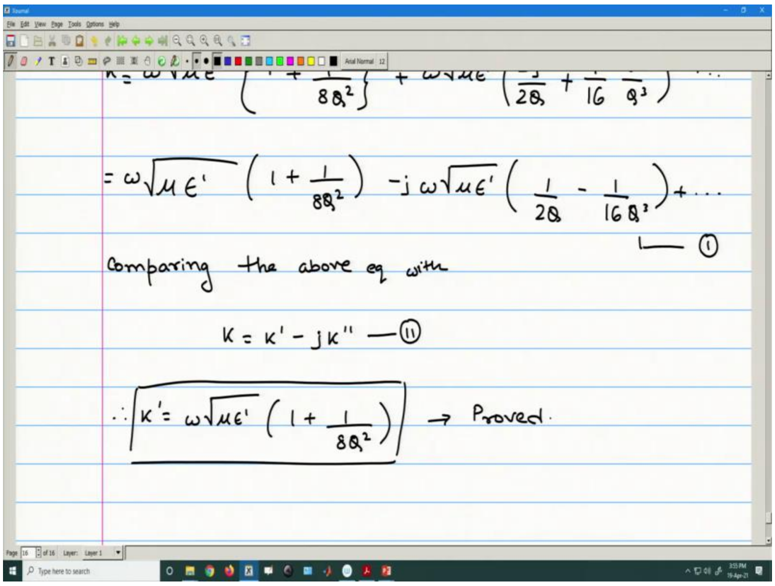
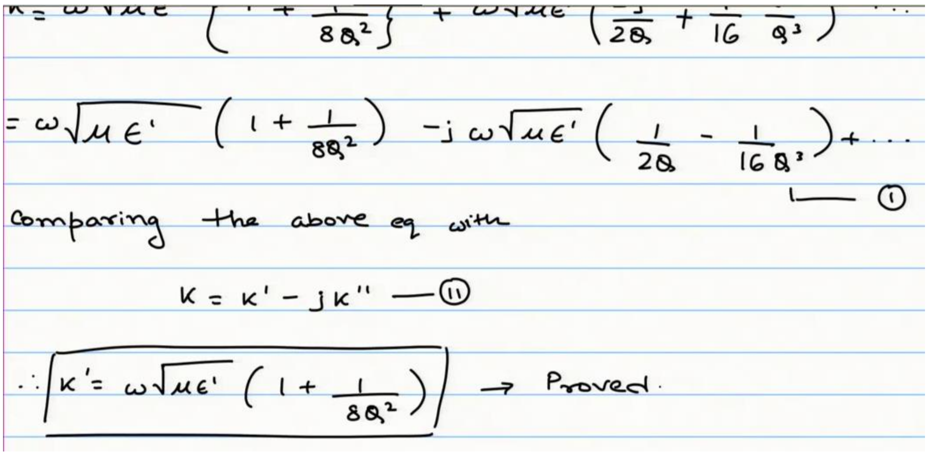




So, let us write it as separating real and imaginary parts, separating the real and imaginary parts,



So, this we got this is proved.

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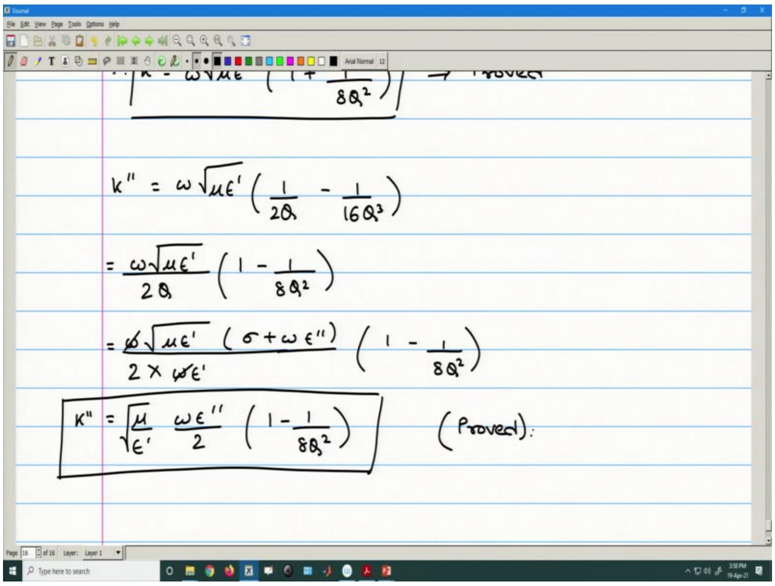

And for k double prime we will take the imaginary part.

$$k'' = \omega\sqrt{\mu\epsilon'}\left(\frac{1}{2Q} - \frac{1}{16Q^3}\right)$$

$$= \frac{\omega\sqrt{\mu\epsilon'}}{2Q}\left(1 - \frac{1}{8Q^2}\right)$$

$$= \frac{\omega\sqrt{\mu\epsilon'}\,(\sigma + \omega\epsilon'')}{2 \times \omega\epsilon'}\left(1 - \frac{1}{8Q^2}\right)$$

$$\boxed{k'' = \sqrt{\frac{\mu}{\epsilon'}}\;\frac{\omega\epsilon''}{2}\left(1 - \frac{1}{8Q^2}\right)} \quad \text{(Proved).}$$

So, this is also proved. Now further resistance and the reactants. So, for that we will start with the eta.

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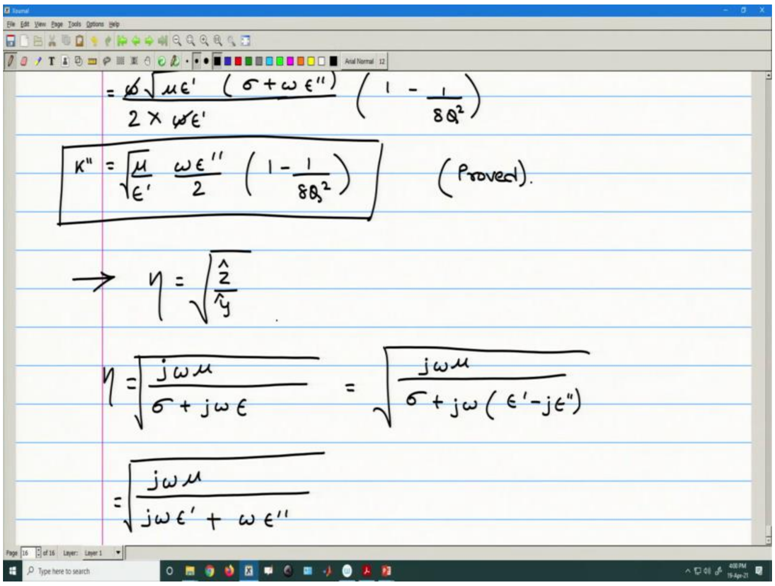

So, first and second done, for third and fourth we will start with we know eta is given by

$$\rightarrow \eta = \sqrt{\frac{\hat{z}}{\hat{y}}}$$

$$\eta = \sqrt{\frac{j\omega\mu}{\sigma + j\omega\epsilon}} = \sqrt{\frac{j\omega\mu}{\sigma + j\omega(\epsilon' - j\epsilon'')}}$$

$$= \sqrt{\frac{j\omega\mu}{j\omega\epsilon' + \omega\epsilon''}}$$

$$= \sqrt{\frac{\mu}{\epsilon'}} \left[\frac{j\omega}{j\omega + \frac{\omega\epsilon''}{\epsilon'}}\right]^{1/2}$$

$$= \sqrt{\frac{\mu}{\epsilon'}} \left\{\frac{j\omega\epsilon'}{j\omega\epsilon' + \omega\epsilon''}\right\}^{1/2}$$

$$= \sqrt{\frac{\mu}{\epsilon'}} \left\{\frac{1}{1 + \frac{\omega\epsilon''}{j\omega\epsilon'}}\right\}^{1/2}$$

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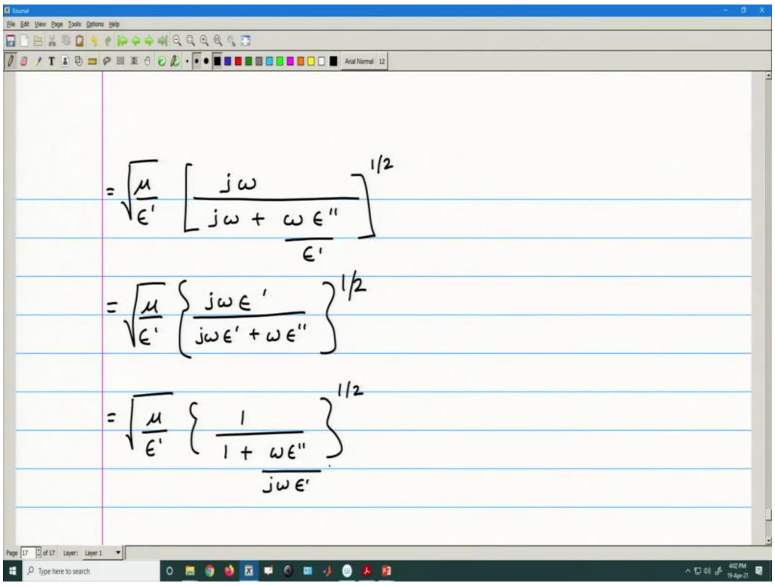
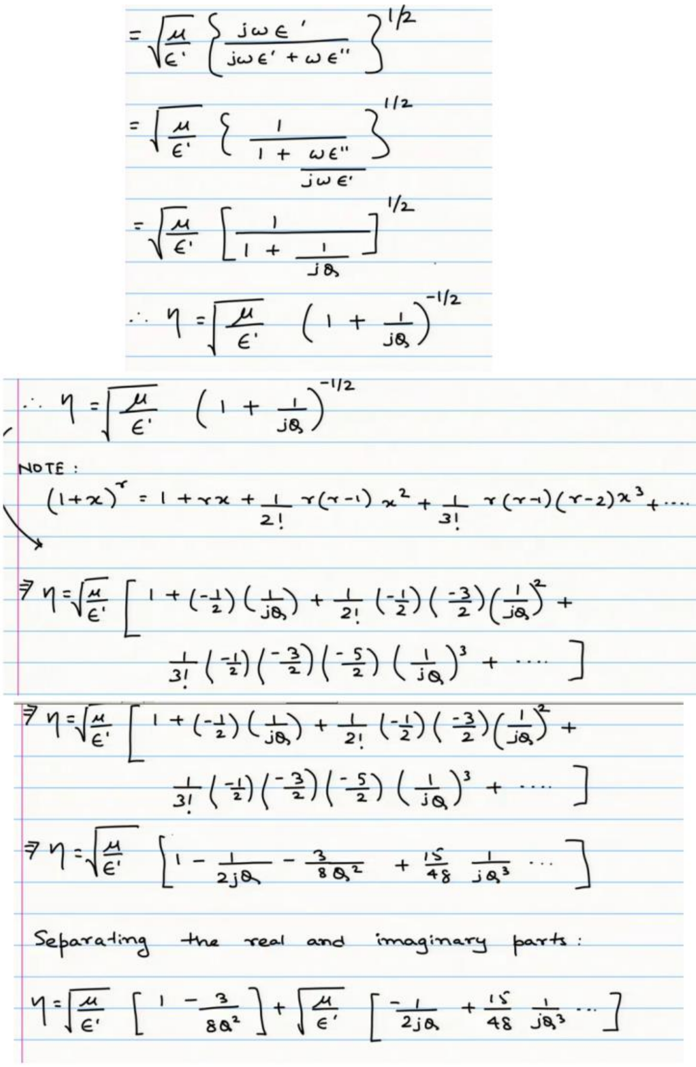


That is we can write it as



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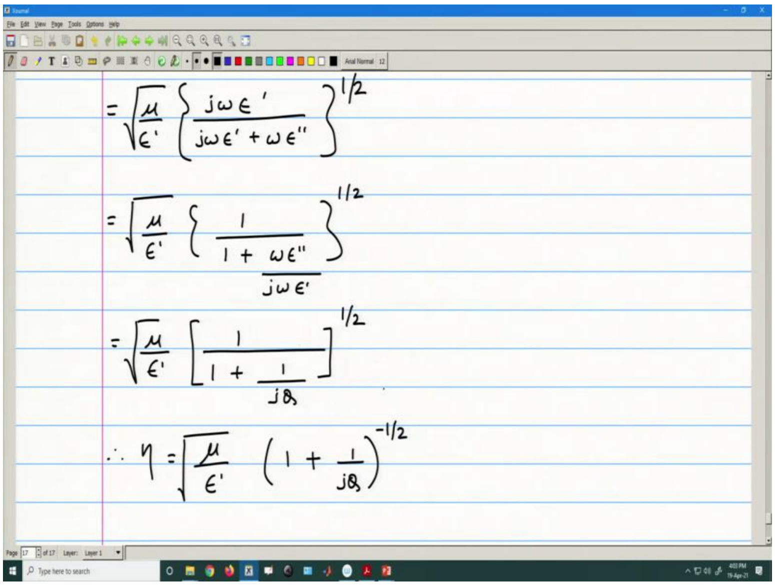

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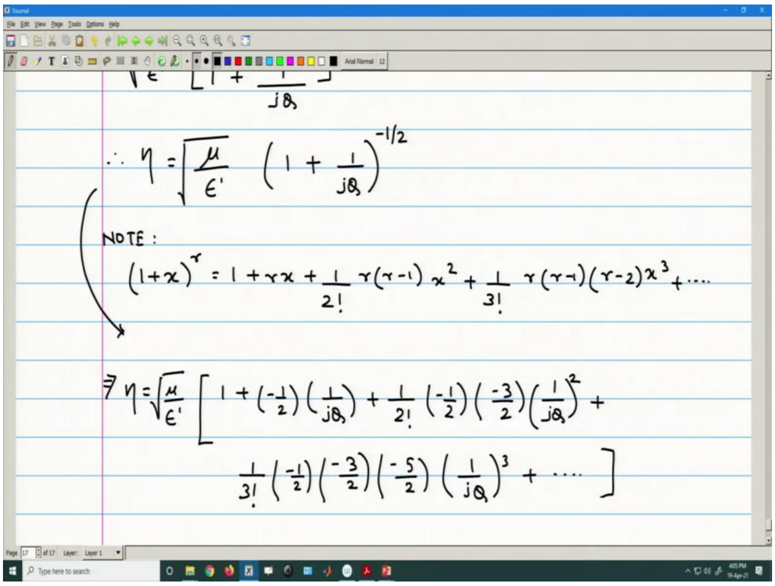

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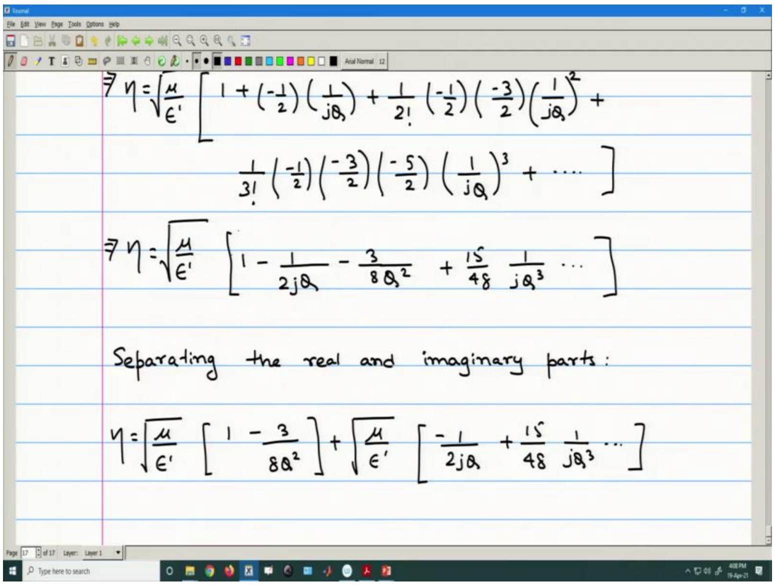
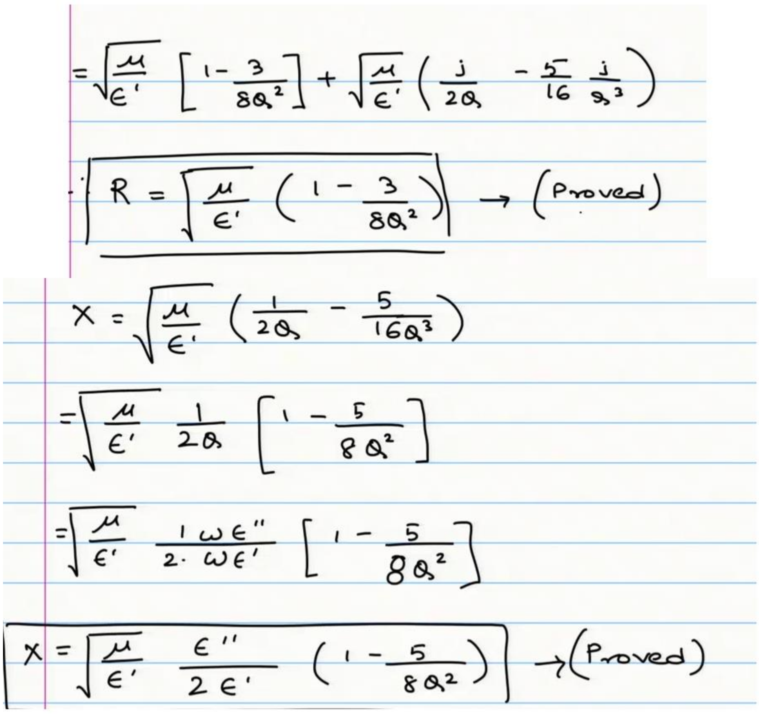


So, separating the real and imaginary parts, separating the real and imaginary parts as we will get



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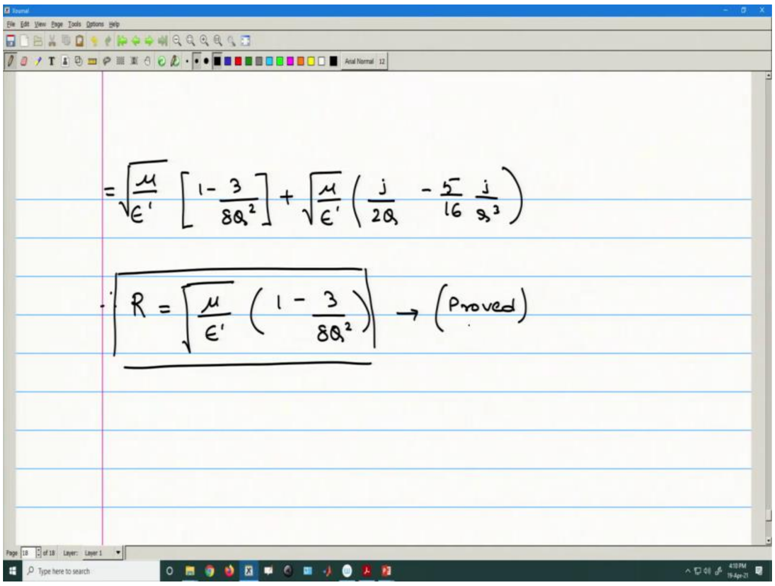

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So, our next class we will also solve some few more problems on wave numbers and then we will move into electric current source. Thank you.