

Task 1 (unmarked)

For the treatment of the retarded, advanced, and Feynman Green functions of the wave equation, we will need the full formalism of complex contour integration, and Cauchy's residue theorem, as well as Jordan's lemma.

Please review all material that you have on these topics from previous courses, and prepare, for yourself, a "cheat sheet" with the most important, pertinent formulas. Be prepared to ask questions on this topic on Tuesday, if there are any left.

Please also try to read the distributed lecture notes as best as possible. Use pertinent sections in the lecture notes for inspiration.

This task is obviously due on Tuesday.

Task 2 (80 points)

In the lecture, we had described the electric field of a propagating plane wave as

$$\vec{E}(\vec{r}, t) = \hat{e}_{\vec{k}\lambda} E_0 \cos(\vec{k} \cdot \vec{r} - \omega t + \phi) \quad (1)$$

or, in the complex formalism, as

$$\vec{E}(\vec{r}, t) = \hat{e}_{\vec{k}\lambda} E_0 e^{i\vec{k} \cdot \vec{r} - \omega t + \phi} \quad (2)$$

The magnetic field followed from the Maxwell equations in both cases.

Now, explore, using the internet, how the above formulas need to be generalized for circular polarization(s), both with positive as well as negative helicity.

Now, specialize the complex formalism to the case $\vec{k} = k_z \hat{e}_z$. Show that you naturally encounter the complex polarization vectors

$$\hat{e}_+ = \frac{1}{\sqrt{2}} (\hat{e}_x + i\hat{e}_y), \quad \hat{e}_- = \frac{1}{\sqrt{2}} (\hat{e}_x - i\hat{e}_y). \quad (3)$$

This task is due on Thursday, with a possibility for an extension.

Task #1 is due Tuesday, 22-SEP-2026. Task #2 is due Thursday, 24-SEP-2026.