Review

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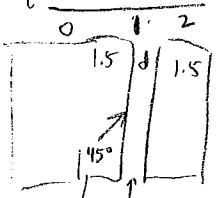
Frustrated T.I.R. (θ_1 = complex, have to use original formula, not $\frac{T_{max}^2}{1+F\sin^2\frac{\phi}{2}}$)

Specific Application



$n_0 = 1.5$ $\theta_0 = 45°$ $\sin\theta_0 = \frac{1}{\sqrt{2}}$ $\cos\theta_0 = \frac{1}{\sqrt{2}}$

$n_1 = 1$

$n_2 = 1.5$

→ p-polarized Microwaves $\lambda = .03m$

$n_0 \sin\theta_0 = n_1 \sin\theta_1$

$1.5\left(\frac{1}{\sqrt{2}}\right) = 1 \sin\theta_1 \rightarrow \theta_1 = 1.5708 + -.3466i$

$\cos\theta_1 = .35355i = \frac{i}{2\sqrt{2}}$

$= \sqrt{1-\sin^2\theta_1}$

$= \sqrt{1-\left(\frac{1.5}{\sqrt{2}}\right)^2}$

$k_1 = \frac{2\pi}{\lambda}$ $\theta_2 = \sin^{-1}\theta_0 \rightarrow \cos\theta_2 = \frac{1}{\sqrt{2}}$

To use big eqn, still need t^{01}, t^{12}, r^{10}, and r^{12}

$t^{01} = \frac{2}{\alpha+\beta} = \frac{2}{\frac{n_1}{n_0}+\frac{\cos\theta_1}{\cos\theta_0}} = \frac{2}{\frac{1}{1.5}+\frac{i/2\sqrt{2}}{1/\sqrt{2}}} = 1.92-1.44i$ $|t^{01}|^2 = 5.76$

$t^{12} = \frac{2}{\alpha+\beta} = \frac{2}{\frac{n_2}{n_1}+\frac{\cos\theta_2}{\cos\theta_1}} = \frac{2}{\frac{1.5}{1}+\frac{1/\sqrt{2}}{i/2\sqrt{2}}} = .48+.64i$ $|t^{12}|^2 = .64$

$r^{10} = \frac{\alpha-\beta}{\alpha+\beta} = \frac{-\frac{n_0}{n_1}+\frac{\cos\theta_0}{\cos\theta_1}}{\frac{n_0}{n_1}+\frac{\cos\theta_0}{\cos\theta_1}} = \frac{-\frac{1.5}{1}+\frac{1/\sqrt{2}}{i/2\sqrt{2}}}{\frac{1.5}{1}+\frac{1/\sqrt{2}}{i/2\sqrt{2}}} = .28-.96i = e^{i(-1.287\cos\theta_1)}$

have class work out. Divide in 4's

r^{12} = same as r^{10} since material 2 = material 0

Put together:

$$T^{02} = \frac{n_2}{n_0}\frac{\cos\theta_2}{\cos\theta_0}\frac{|t^{01}|^2|t^{12}|^2}{\left|e^{-ik_1 d\cos\theta_1} - r^{10,12}e^{ik_1 d\cos\theta_1}\right|^2}$$

→ Mathematica!

Set this to Plot

$$= \frac{(5.76)(.64)}{\left|e^{-i\left(\frac{2\pi}{.03}\right)d\left(i/2\sqrt{2}\right)} - \left(e^{i(-1.287)}e^{i(-1.287)}\right)e^{i\left(\frac{2\pi}{.03}\right)d\,i/2\sqrt{2}}\right|^2}$$

$$= \frac{3.6864}{\left|e^{+74.05d} - e^{-i2.574}e^{-74.05d}\right|^2}$$

$$= \frac{3.6864}{\left(e^{74.05d} - e^{-i2.574}e^{-74.05d}\right)\left(e^{74.05d} - e^{+i2.574}e^{-74.05d}\right)}$$

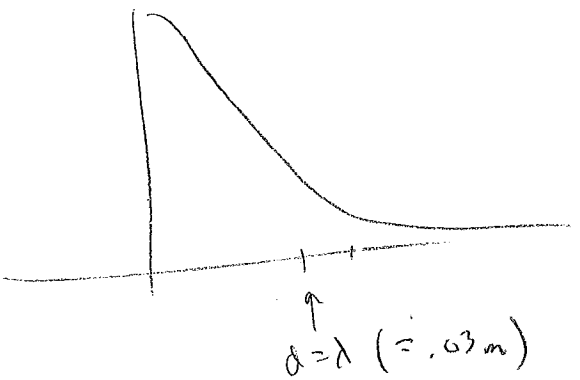
Skip

$$T^{02} = \frac{3.6864}{e^{148.10} - \left(e^{i2.574} + e^{-i2.574}\right) + e^{-148.10}}$$

$$2\cos 2.574 = -1.68632$$

$$T^{02} = \frac{3.6864}{e^{148.10} + e^{-148.10} + 1.68632}$$

plotted w/ MathematicA - in PowerPoint



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(Quizzes)

sec 6.5 Fabry-Perot ... Back to F-P Eqn.

consider ... 0-2, like air glass air or glass air glass

then

$T_{max} = \frac{(T_{01})(T_{12})}{(1-\sqrt{R_{10}}\sqrt{R_{12}})^2}$ ← eqn 1

$T_{max} = \frac{T_{01}\,T_{12}}{(1-R)^2} = \frac{T^2}{(1-R)^2}$

↓ is not $T = 1-R$?
• If absorption, then $T = 1-R-A$
But if $A=0$ then $T_{max}=1$

• Proof that $T_{01} = T_{12}$:
for p-polar (skip this)
$T = 1-R = 1-\left(\frac{\alpha-\beta}{\alpha+\beta}\right)^2 = \frac{4\alpha\beta}{(\alpha+\beta)^2} \times \frac{(1/\alpha\beta)^2}{(\frac{1}{\alpha\beta})^2}$
$= \frac{4\frac{1}{\alpha}\frac{1}{\beta}}{(\frac{1}{\beta}+\frac{1}{\alpha})^2}$
so $T_{01} = T_{12} = T$

$F = \frac{4|r^{10}||r^{12}|}{(1-|r^{10}||r^{12}|)^2}$

$= \frac{4R}{(1-R)^2}$

Plot of $T = \frac{T_{max}}{1+F\sin^2\frac{\delta}{2}}$

$\delta = \delta_{10}+\delta_{12}$ ... $+ 2k_1 d\cos\theta_1$
(typically less important thing (unchanging))
$= \frac{4\pi}{\lambda_1} d\cos\theta_1$
$= \frac{4\pi n_1}{\lambda_{vac}} d\cos\theta_1$

Can vary δ via ① d, ② θ_1, or ③ λ_{vac}

T_{max}

$\frac{T_{max}}{1+F}$

(Rough Overhead) ~~To get large F → want large R (R=.9 → F=360)~~

~~(... T_{max} ...)~~

~~Plot on Powerpoint~~