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b

Wave vector ($\bar{K}$):

The $\bar{K}$ wave vector specifies the direction and the wave number of a plane wave in 3D-space.

Since $K = \omega\sqrt{\epsilon\mu}$ $\quad \bar{K} = K\hat{K}$ or $\bar{K} = K\hat{u}$

While phase velocity $v = \frac{1}{\sqrt{\epsilon\mu}}$

or $\sqrt{\epsilon\mu} = \frac{1}{v}$

$$K = \frac{\omega}{v}$$

Hint: $\bar{K} \parallel \bar{r}$

$\bar{K}.\bar{r} - \omega t = \text{Const}$

$\frac{d}{dt}(Kr) - \frac{d}{dt}(\omega t) = 0$

$K\frac{dr}{dt} - \omega = 0$

$Kv - \omega = 0$

$(K = \frac{\omega}{v})$

Also $\omega = 2\pi f$

$$K = \frac{2\pi f}{v}$$

The speed of a wave $v = f\lambda$

$$K = \frac{2\pi \cancel{f}}{\cancel{f}\lambda} = \frac{2\pi}{\lambda}$$

$K = \frac{2\pi}{\lambda}$ it has unit $\left(\frac{rad}{m}\right)$

K wave number is also defined as number of radians per unit length & also termed as angular wave number, circular wave number or wave number.

"K" wave number is also defined

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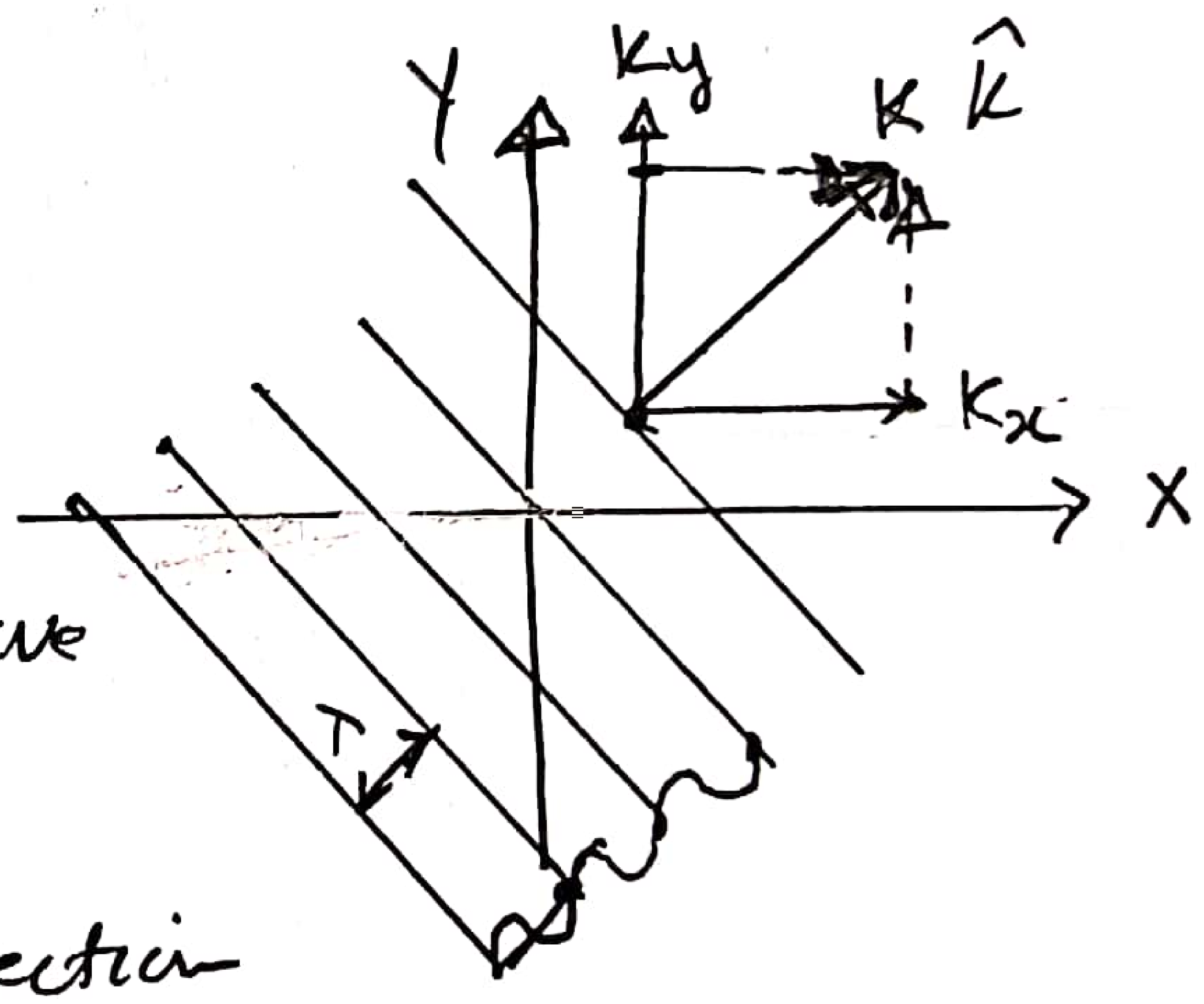
as number of radians Swept by unit wavelength.

$K = \frac{2\pi}{\lambda}$ can also be expressed as angular frequency of wave in space while $\omega = \frac{2\pi}{T}$ is called the angular frequency of wave in time.

$$\omega = \frac{2\pi}{T} = \text{radians}/\text{seconds}$$

$\bar{K} = k\hat{k}$

$\bar{K} = K_x\hat{i} + K_y\hat{j}$



In figure plan wave fronts of the wave in xy-plane is direction along the resultan $\bar{K}$ wave vector which is perpendicular to the plane of The wave. $\bar{K}$ wave vector has two components K_x & K_y along each x & y axis respectively. K & ω are Space-Time angular frequencies