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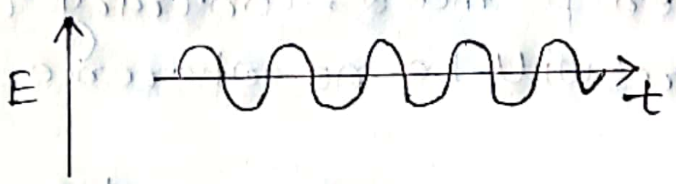
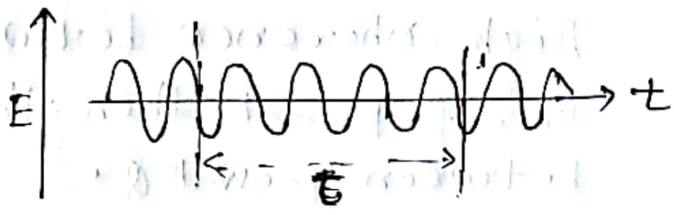
Temporal and spatial coherences.

If a wave appears to be a pure Sine wave for an infinitely large period of time or infinitely extended space, then it is called a perfectly coherence wave. It has a definite relationship between the phase of the wave at a given time and at a certain time later, or at a given point and at a Certain distance away. NO light Source emits a perfectly coherent wave. Light waves are partially coherent waves.

Temporal Coherence:— The oscillating electric field of a perfectly Coherent light wave would have a Constant amplitude of vibration at any point and its phase would vary linearly with time. Figure shows that field as a function of time which is an ideal Sinusoidal function of time

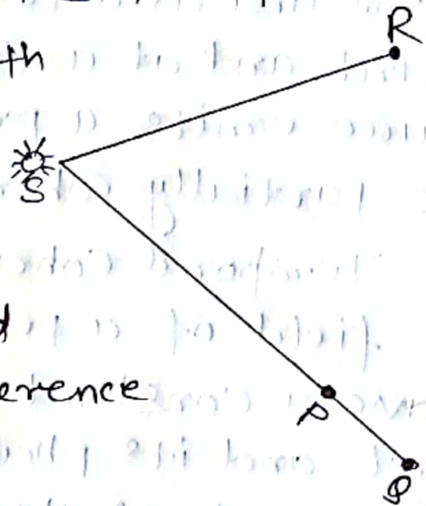




No actual light Source emit light waves which produce an ideal Sinusoidal field for all values of time because the light waves are emitted in the form of pulse of short duration. Thus the field remains Sinusoidal for time-intervals of the order of 10^{-10} second, after which the phase abruptly. If figure shows the field due to an actual light Source. The average time-interval for which the field remaining sinusoidal is known as 'coherence light' or 'temporal coherence' of light beam. It is denoted by τ. The distance for which the field remains sinusoidal is $L = \tau c$, where c is the speed of light. L is called the coherence light of the light beam.

(ii) spatial Coherence :- It is the phase relationship between the radiation field at different point in space. Consider light waves emitted from a source S, ~~let~~

Let p and Q be the two point lying on a line joining them with Source S. The phase relationship between p and Q depends on the distance PQ and on the temporal coherence of the beam.



If $PQ << L$, then there will be a definite phase relationship between p and Q i.e. a high coherence between p and Q. Contrary to it, if $PQ >> L$, then there will be no coherence between p and Q.

Now, we consider two point p and R, equidistant from S. If S is true 'point source' then the wave shall reach p and R exactly in the same phase i.e. the two points are in perfect 'spatial coherence'. For extended source, the point p and R will no longer remain in coherence.