ASSIGNMENT11.15_13Q

EE22BTECH11219 - Sai Sujan Rada

QUESTION:

Given below are some functions of x and t to represent the displacement (transverse or longitudinal) of an elastic wave. State which of these represents (*a*) travelling wave, (*ii*) a stationary wave or (*iii*) none at all:

(a) $y = 2\cos(3x)\sin(10t)$

(b) $y = 2\sqrt{x - vt}$

(c) $y = 3\sin(5x - 0.5t) + 4\cos(5x - 0.5t)$

(d) $y = \cos x \sin t + \cos 2x \sin 2t$

SOLUTION:

TRAVELLING WAVE:

The general equation of a travelling wave is,
$y(x,t) = A\sin(kx \pm \omega t)$
Here, the amplitude of the wave is A, it's angular velocity is ω and it's position is x and it's wavenumber is k.

STATIONARY WAVE:

The general equation of a stationary wave is,
$y(x,t) = A\sin kx\cos\omega t$
Here, the amplitude of the wave is A, it's angular velocity is ω and it's position is x and it's wavenumber is k.

TRAVELLING WAVE	STATIONARY WAVE
$y(x,t) = A\sin(kx \pm \omega t)$	$y(x,t) = A\sin kx\cos\omega t$
A=Amplitude, ω=angular velocity, x=position of the particle, k=wavenumber	A=Amplitude, ω=angular velocity, x=position of the particle, k=wavenumber

TABLE 0
TRAVELLING WAVE *vs* STATIONARY WAVE

(*a*) The given equation is: $y = 2\cos(3x)\sin(10t)$

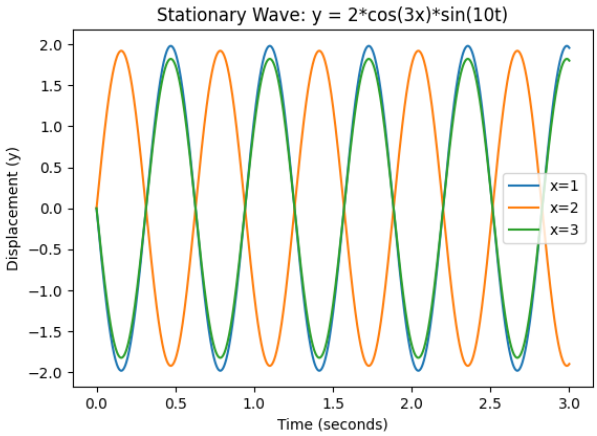

Fig. 0. DIPLACEMENT *vs* TIME-graph1

We can observe the nodes and antinodes in the graph with fixed spatial pattern and different amplitude peaks at various positions of x maintaining symmetry with axis.This shows that the graph is stationary or a standing wave.

(*b*) The given equation is: $y = 2\sqrt{x - vt}$

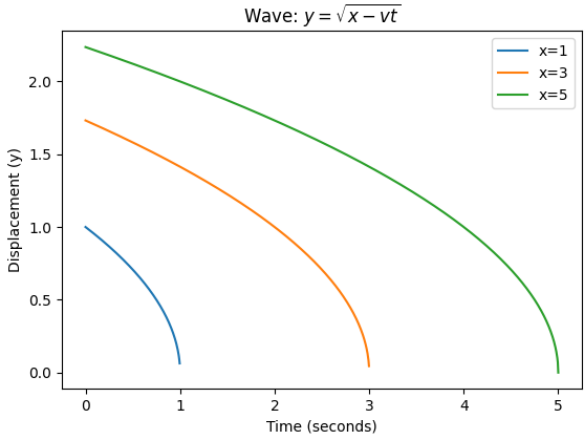

Fig. 0. DIPLACEMENT *vs* TIME-graph2

We can observe the graph and conclude that the given equation is not a wave as there is no periodic

oscillation and proper wave shape.

(*c*) The given equation is: $y = 3\sin(5x - 0.5t) + 4\cos(5x - 0.5t)$

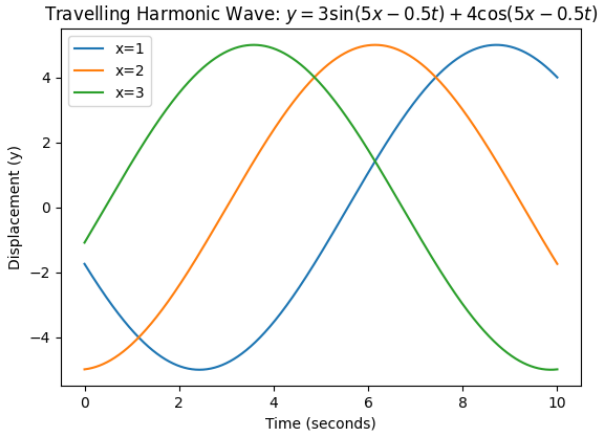

Fig. 0. DIPLACEMENT *vs* TIME-graph3

We can observe the graph having exhibiting periodic oscilltions with equal amplitude and proper sinusoidal wave shape uniformly. Thus, we can conclude that is a travelling wave.

(*d*) The given equation is: $y = \cos x \sin t + \cos 2x \sin 2t$

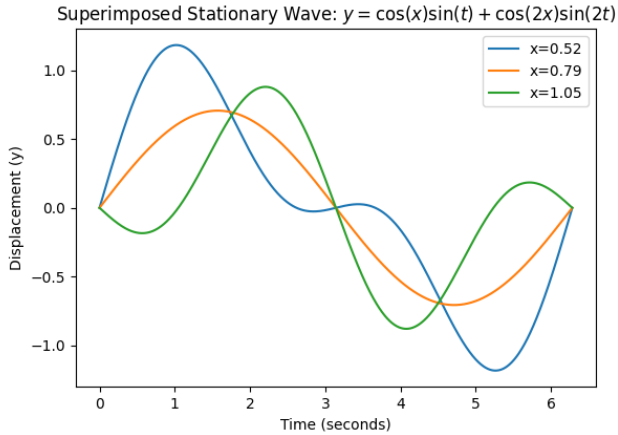

Fig. 0. DIPLACEMENT *vs* TIME-graph3

We can observe fixed spatial patter but with multiple frequencies. The graph even shows interference patterns having uniformity by which we can say it is a superimposed stationary wave equation.