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 (i) travelling wave, (ii) a stationary wave or (iii) none at all:

1) $y = 2\cos(3x)\sin(10t)$
2) $y = 2\sqrt{x - vt}$
3) $y = 3\sin(5x - 0.5t) + 4\cos(5x - 0.5t)$
4) $y = \cos x \sin t + \cos 2x \sin 2t$

Solution:

TRAVELLING WAVE	STATIONARY WAVE
$y(x,t) = A\sin(kx \pm \omega t)$	$y(x,t) = A\sin kx \cos \omega t$
PARAMETERS	DEFINITION
A	Amplitude
ω	Angular Velocity
x	Position
k	Wavenumber

TABLE I
TRAVELLING WAVE *vs* STATIONARY WAVE

Let us assume an equation:

$$y = A(x)\cos(\omega t + \phi(x)) \tag{1}$$

Fig. 1 and Fig. 3 are self explanatory for stationary and travelling waves. Fig. 2 and Fig. 4 are neither stationary nor travelling waves.

STATIONARY WAVE CONDITION	TRAVELLING WAVE CONDITION
(1) $A(x)$ should be a function of position x, and it can be expressed as $A(x) = A_0 cos(\omega t + \alpha)$ where A_0 is a constant, k is the wavenumber, x is the position and α is a phase constant.	(1) $A(x)$ should be a constant, and it can be expressed as $A(x) = A_0$ where A_0 is a constant number.
(2) $\phi(x)$ can be expressed as $\phi(x) = c$ where c is a constant.	(2) $\phi(x)$ represents a linear expression in x, and it can be expressed as $\phi(x) = kx + \theta$ where k is the wavenumber and θ is the phaseconstant.

TABLE II
TRAVELLING WAVE *vs* STATIONARY WAVE

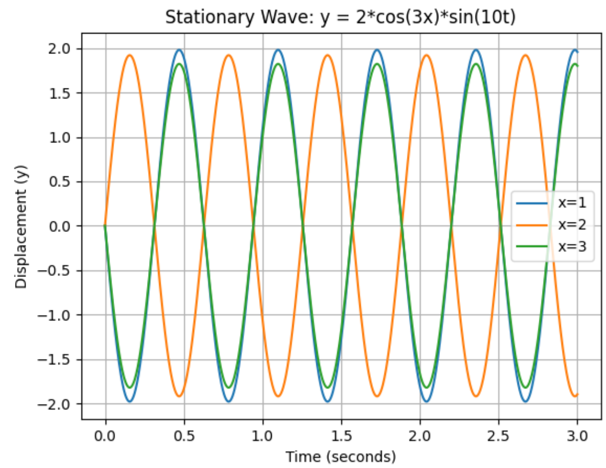

Fig. 1. DIPLACEMENT *vs* TIME-graph1

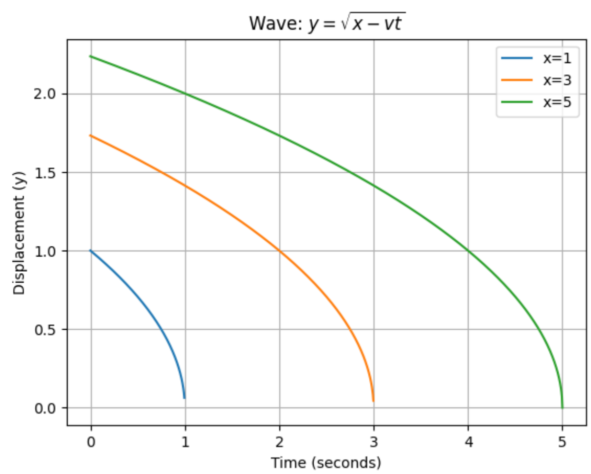

Fig. 2. DIPLACEMENT *vs* TIME-graph2

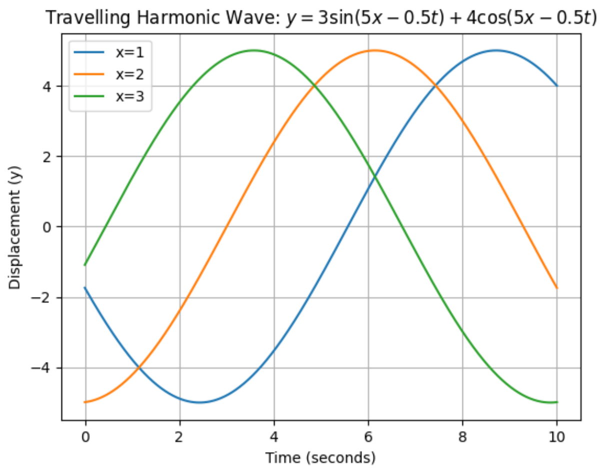

Fig. 3. DIPLACEMENT *vs* TIME-graph3

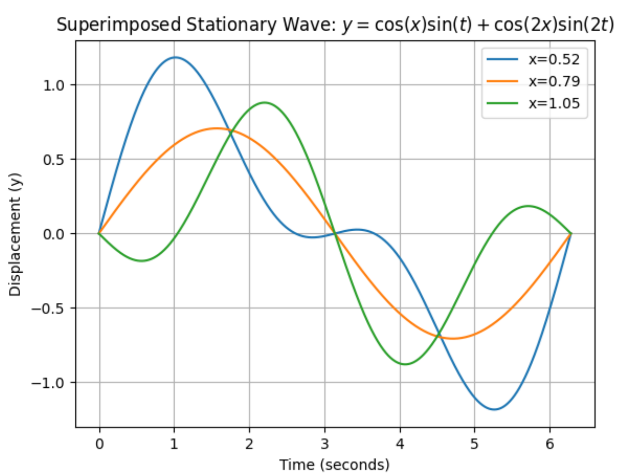

Fig. 4. DIPLACEMENT *vs* TIME-graph4