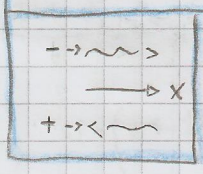
7. auditorna vježba

z1) $y(x,t) = 0.05 \cdot \sin(2\pi t - \pi x)$

$Y = A \sin(\omega t \pm kx)$



a) $A = ?$

$A = 0.05 \ m$

b) $\omega, f, T = ?$

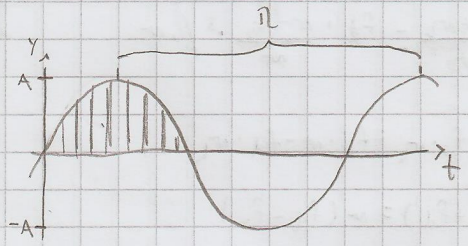
$\omega = 2\pi$

$f = \frac{\omega}{2\pi}$

$f = 1 \ Hz$

$T = \frac{1}{f}$

$T = 1 \ s$



c) v, smjer $= ?$

$v = \lambda \cdot f$

$k = \frac{2\pi}{\lambda}$

$v = \frac{2\pi}{k} \cdot f$

$= \frac{2\pi}{\pi} \cdot 1 = 2 \ m/s$

smjer -> $k < 0$ -> u smjeru X osi

d) $v_{titranja} = ?$

$v_{titranja} = \frac{\partial y}{\partial t}$

$v_{tit} = 0.05 \cdot \cos(2\pi t - \pi x) \cdot 2\pi$

$= 0.05 \cdot \cos(1) \cdot 2\pi$

$v_{max} = 0.05 \cdot 2\pi = 0.314 \ m/s$

e) $a_{titranja} = ?$

$a_{titranja} = \frac{\partial v}{\partial t}$

$a_{tit} = 0.1\pi \cdot [-\sin(2\pi t - \pi x)] \cdot 2\pi$

$= 0.2\pi^2 = 1.974 \ m/s^2$

f) $y, v_{tit} = ?$

$x = 3.6 \ m$

$t = 5 \ s$

$y(3.6, 5) = 0.05 \cdot \sin(2\pi \cdot 5 - 3.6\pi)$

$= 0.04755 \ m$

$v_{tit}(x,t) = 0.1\pi \cdot \cos(2\pi \cdot 5 - \pi \cdot 3.6)$

$= 0.097 \ m/s$

z2) $A = 5 \ cm = 0.05 \ m$

$\lambda = 0.5 \ m$

$f = 3 \ Hz$

$u(0,t) = A \sin(\omega t)$

a) $v = ?$

$v = \lambda \cdot f$

$= 0.5 \cdot 3 = 1.5 \ m/s$

b) $u(x,t) = A \sin(\omega t - kx)$

$k, \omega = ?$

$k = \frac{2\pi}{\lambda}$

$= \frac{2\pi}{0.5} = 4\pi$

$\omega = 2\pi f$

$= 2\pi \cdot 3 = 6\pi$

$u(x,t) = 0.05 \cdot \sin(6\pi t - 4\pi x)$

c) $x = 0.1 \ m$

$t = 0.1 \ s$

$v, v_{tit}, a_{tit} = ?$

$v(0.1, 0.1) = 0.05 \cdot \sin(0.6\pi - 0.4\pi)$

$= 0.02939 \ m$

$v_{t,t} = \frac{\partial u}{\partial t}$

$= 0.05 \cdot \cos(6\pi t - 4\pi x) \cdot 6\pi$

$v_{t,t}(0.1, 0.1) = 0.3 \cdot \cos(0.2\pi)$

$= 0.2427 \ m/s$

$a_{t,t} = \frac{\partial v}{\partial t}$

$= 0.3\pi \cdot [-\sin(6\pi t - 4\pi x)] \cdot 6\pi$

$= -1.8\pi^2 \cdot \sin(6\pi t - 4\pi x)$

$a_{t,t}(0.1, 0.1) = -1.8\pi^2 \cdot \sin(0.2\pi)$

$= -10.442 \ m/s^2$

3) $f = 1.33\dot{3} \ Hz$

$v = \frac{425 \cdot 10^{-2}}{10} = 0.425 \ m/s$

$\pi = ?$

$v = \pi \cdot f$

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

$= \frac{0.425}{1.33} = 0.31875 \ m$

4) $f_s = 8000 \cdot 10^4 \ Hz$

$v_{Zvuk} = 1.5 \ km/s = 1500 \ m/s$

$f_d = 8002 \cdot 10^4 \ Hz$

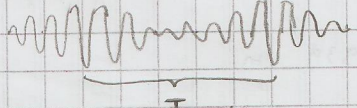
$v_k, f_b, T_b, dijagram = ?$

$f_b = |f_2 - f_1| = f_d - f_s$

$= 8002 \cdot 10^4 - 8000 \cdot 10^4 = 2 \cdot 10^4 \ Hz$

$T_b = \frac{1}{f_b}$

$= \frac{1}{2 \cdot 10^4} = 5 \cdot 10^{-5} \ s$



$f_d = f_s \cdot \frac{v_{Zvuka} \pm v_d}{v \mp v_s}$

1: 1 ⇝ ⊙

$f_d' = f_s \cdot \frac{v + v_d}{v - 0} \qquad v_k = v_d$

2: 1 < ⇝ ⊙

$f_d = f_s' \cdot \frac{v + 0}{v - v_s} \qquad v_k = v_s$

$f_d' = f_s'$

$f_s \cdot \frac{v + v_k}{v} = f_d \cdot \frac{v - v_k}{v} \quad / \cdot v$

$f_s \cdot v + f_s \cdot v_k = f_d \cdot v - f_d \cdot v_k$

$v_k (f_s + f_d) = v (f_d - f_s)$

$v_k = v \cdot \frac{f_d - f_s}{f_d + f_s}$

$= 1500 \cdot \frac{2 \cdot 10^4}{16002 \cdot 10^4} = 0.1875 \ m/s$

25) $Y_1(t) = A \sin(\omega t - kx - \phi_1)$

$Y_2(t) = A \sin(\omega t - kx - \phi_2)$

$f = 50 \ Hz \qquad F = 50 \ N$

$A = 3 \ cm = 0.03 \ m$

$\phi_2 - \phi_1 = 130^0 \qquad \mu = 0.1 \ kg/m$

$\bar{P}_1, \bar{P}_2, \bar{P}_r (Y_{12}) = ?$

$\bar{P} = \frac{\mu}{2} \cdot \omega^2 \cdot A^2 \cdot v$

$v = \sqrt{\frac{T}{\mu}}$

$\bar{P} = \frac{(2\pi f)^2 \cdot A^2}{2} \cdot \sqrt{\frac{F \cdot \mu^2}{\mu}} = 2\pi^2 f^2 \cdot A^2 \cdot \sqrt{F \cdot \mu}$

$\omega = 2\pi f$

$\bar{P}_1 = \bar{P}_2 = 2 \cdot \pi^2 \cdot 50^2 \cdot 0.03^2 \cdot \sqrt{50 \cdot 0.1} = 99.31 \ W$

$Y_{12} = Y_1 + Y_2$

$= A[\sin(\omega t - kx - \phi_1) + \sin(\omega t - kx - \phi_2)]$

$$= \left| \sin\alpha + \sin\beta = 2 \cdot \sin\left(\frac{\alpha+\beta}{2}\right) \cdot \cos\left(\frac{\alpha-\beta}{2}\right) \right|$$

$$= A \cdot 2 \cdot \sin\left(\frac{wt - kX - \phi_1 + wt - kX - \phi_2}{2}\right) \cdot \cos\left(\frac{wt - kX - \phi_1 - wt + kX + \phi_2}{2}\right)$$

$$= A \cdot 2 \sin\left(\frac{2wt - 2kX - \phi_1 - \phi_2}{2}\right) \cdot \cos\left(\frac{\phi_2 - \phi_1}{2}\right)$$

$$= 2 \cdot A \cdot \cos\left(\frac{\phi_2 - \phi_1}{2}\right) \cdot \sin\left(wt - kX - \frac{\phi_1 + \phi_2}{2}\right)$$

$$\bar{P}_r = 2 \cdot \pi^2 \cdot f^2 \cdot \left[2 \cdot A \cdot \cos\left(\frac{\phi_2 - \phi_1}{2}\right)\right]^2 \cdot \sqrt{F \cdot \mu}$$

$$= 2 \cdot \pi^2 \cdot 50^2 \cdot \left[2 \cdot 0.03 \cdot \cos\left(\frac{130^\circ}{2}\right)\right]^2 \cdot \sqrt{50 \cdot 0.1}$$

$$= 70.95 \text{ W}$$