Seminary exercise Nr. 9
Waves

1. The form of a wave equation is $u(x,t)=A\sin(Bx-Ct)$, where t is the time in seconds, x is the space coordinate in meters and $A=3\cdot10^{-4}m$, $B=5.55m^{-1}$, $C=1887s^{-1}$. Find the frequency, the phase velocity and the wavelength of the sinusoidal wave.

2. The equation of a transverse wave traveling along a very long string is $y=6\sin(0.020\pi x-4\pi t)$, where x and y are expressed in centimeters and t is in seconds. Determine the amplitude, the wavelength, the frequency, the phase velocity and the maximum transverse velocity of a particle in the string. What is the transverse displacement at $x=3.5cm$ when $t=0.26s$?

3. Determine the phase velocity for the longitudinal and transversal waves in a steel rod. The material constants of steel are $E=210GPa$, $G=80GPa$, $\rho=7850kgm^{-3}$.

4. A sinusoidal wave travels along a string. The time for a particular point to move from the maximum displacement to zero is $0.170s$. What are the period and frequency? If the wavelength is $1.4m$, what is the wave speed?

5. A string of length $120cm$ is stretched between fixed supports. What are the longest, second longest, and third longest wavelengths for waves traveling on the string if standing waves are to be set up? What is the node-to-node distance for these wavelengths?

6. A standing wave generated in the air column has an average node-to-node distance of $9.3cm$. What is the wavelength of the standing wave? What is the wave frequency if the sound speed in air is $344ms^{-1}$?

7. An ambulance with a siren emitting a whine at $1600Hz$ overtakes and passes a cyclist riding a bike at $2.44ms^{-1}$. After being passed, the cyclist hears a frequency of $1590Hz$. How fast is the ambulance moving? The sound speed in air is $344ms^{-1}$.

8. A point source emits $30W$ of sound isotropically. A small microphone intercepts the sound $200m$ from the source. Calculate the sound intensity and the sound intensity level there. The threshold of hearing intensity is $I_0=1\cdot10^{-12}Wm^{-2}$.

9. The intensity of the waves $2.50m$ from the source is $1.91\cdot10^{-4}Wm^{-2}$. Assuming that the energy of the waves is conserved, find the power of the source.

10. The sound intensity level decreases by $20dB$ at the same point of detection. What is the corresponding change of the sound intensity?

11. Determine the sound intensity level for the threshold of hearing intensity I_0.