

Homework Problem Set #1

(Due by 2008/03/10)

This problem set covers the content of Lessons 1–2 or EK 12.1-12.4.

- 1) (10%) Problem **12.1.13**. Just prove the case of “two” independent variables.

- 2) How to modify the 1-D wave equation [eq. (1.1) of the lecture notes], if:
 - 2a) (10%) the mass density of the string is nonuniform?
 - 2b) (5%) the gravitational force ($F=mg$) matters?

- 3) Consider a string of length 0.5 m, mass density 10 g/m, horizontal tension 100 Nt, with two ends fixed at zero-displacement. The initial displacement and velocity are $\phi(x)$ and zero, respectively.
 - 3a) (10%) Show the motion of the string graphically, if $\phi(x)=0.01 \cdot \sin(2\pi x)$.
 - 3b) (5%) What is(are) the frequency(frequencies) of vibration?
 - 3c) (5%) How do the results of 3a, 3b change if the string tension becomes 200 Nt?
 - 3d) (20%) Show the motion of the string graphically, if $\phi(x)=0.16x(0.5-x)$ (tension remains 100 Nt). You are encouraged to plot curves at different instants by computer program.
 - 3e) (5%) What is(are) the frequency(frequencies) of vibration?

- 4) (10%) Problem **12.4.5**.

- 5) (20%) Solve: $u_{tt} = c^2 u_{xx}$, with ICs: $u(x,0)=0$, $u_t(x,0) = \begin{cases} 1, & -1 < x < 1 \\ 0, & \text{otherwise} \end{cases}$.

Note: you have to specify the function form of $u(x,t)$ for $\{-\infty < x < \infty, 0 < t < \infty\}$.