EE Quals (2009)
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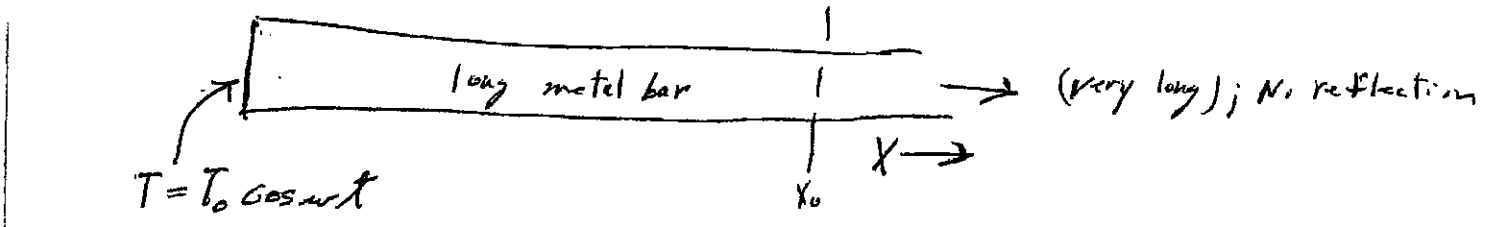
The first portion of the exam was qualitative and took somewhat different directions with different students. The overall discussion was, in all cases, on properties of the one-dimensional wave equation as compared to the one dimensional heat flow (diffusion) equation.

We Then considered the following problem:



One end of a metal bar is held at a sinusoidally (steady state) temperature $T = T_0 \cos \omega t$.

Making use of the heat equation

$$\frac{\partial T}{\partial t} = \kappa \frac{\partial^2 T}{\partial x^2}$$

Find the temperature as a function of time at the dashed line.

→ First recognize that any linear system driven by a sinusoid responds at the drive frequency. Therfore the waveform at $x = x_0$ will differ, at most, in amplitude and phase from that at the boundary.