工程數學 (四) - 偏微分方程

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I. Solve the PDE

$$u_{tt} = \begin{cases} 4u_{xx}, & for\ \ x < 0,\ \ t > 0 \\ 1u_{xx}, & for\ \ x > 0,\ \ t > 0 \end{cases}$$

with initial conditions

$$u(x,0) = 0, u_t(x,0) = 0$$

and $u(x,t)$ is continuous across $x = 0$, while

$$u_x(0^+,t) - u_x(0^-,t) = a\ sin(\omega t)$$

where a, ω are two constants.

II. Reflection and transmission due to lump mass, m, in one medium using diamond rule. Solve the PDE

$$u_{tt} = c_1^2 u_{xx}, \quad for\ \ x < 0,\ \ t > 0$$

with initial condition of displacement

$$u(x,0) = \begin{cases} f(x), & for\ \ x > 0 \\ 0, & for\ \ x < 0 \end{cases}$$

with initial condition of velocity

$$u_t(x,0) = \begin{cases} 0, & for\ \ x > 0 \\ 0, & for\ \ x < 0 \end{cases}$$

$u(x,t)$ is continuous across $x = 0$,

$$u(0^+,t) = u(0^-,t)$$

Force can be transmitted across $x = 0$,

$$m\ddot{u}(t) = \rho c_1^2 u_x(0^+,t) - \rho c_1^2 u_x(0^-,t)$$

(1). Determine the ratio of transmission and reflection.

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