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Mathematical Method of Physics

Problems 6

6.1 Solve the following wave equation with damping proportional to velocity,

$$\frac{\partial^2 u(x,t)}{\partial x^2} = \frac{1}{c^2}\frac{\partial^2 u(x,t)}{\partial t^2} + \gamma \frac{\partial u(x,t)}{\partial t} \ ,$$

with the boundary conditions in the form

$$u(0,t) = u(L,t) = 0 \ ,$$

$$u(x,0) = u_0 \sin \frac{\pi x}{L} \ ,$$

and the initial condition

$$\frac{\partial u(x,t)}{\partial t}|_{t=0} = 0 \ .$$

6.2 Find the eigenfunctions and eigenenergies of a particle of mass m which is contained inside a cylinder of radius a and height L.

6.3 In a stationary state, the temperature distribution inside a sphere of radius a is described by the Laplace's equation. Solve it assuming that the surface of the sphere's top half is maintained at constant temperature T_0, while the surface of its bottom half is kept at $T = 0$.

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