initial conditions σ, τ such that the function $u(t, x)$, uniquely given by them, is ω-periodic in t. If we seek σ, τ in the form

$$\sigma(x) = e^{bx} \sum_{k=1}^{\infty} a_k \sin kx\,, \quad \tau(x) = e^{bx} \sum_{k=1}^{\infty} b_k \sin kx\,,$$

(a_k, b_k being Fourier coefficients of σ and τ, respectively) we obtain the following result:

Let the function $h(t, x)$ be continuous and have the continuous derivative of the third order with respect to x. Further, let

$$h(t, 0) = h(t, \pi) = 0\,, \quad h_{xx}(t, 0) = h_{xx}(t, \pi) = 0$$

and h be ω-periodic in t. Then if there is $a \neq 0$, $b^2 + c \neq -k^2$ for all $k = 1, 2, \ldots$, the problem (3.6) and (3.1) has a unique ω-periodic solution $u(t, x)$.

If $b^2 + c = -k_0^2$ for some k_0 and if $h(t, x)$ has continuous derivative of the first order, only, it may be possible to find (by the same way) a necessary condition that the problem (3.6) and (3.1) have ω-periodic solutions. Denoting

$$H(\omega, x) = \int_0^{\omega} \int_{x-\omega+\vartheta}^{x+\omega-\vartheta} J_0(d^{\frac{1}{2}}((\omega - \vartheta)^2 - (x - z)^2)^{\frac{1}{2}})\, h(\vartheta, z)\, \mathrm{d}z\, \mathrm{d}\vartheta$$

this condition is

$$\frac{a}{k_0} \int_0^{2\pi} H_x(\omega, x) \cos k_0 x\, \mathrm{d}x + \int_0^{2\pi} H(\omega, x) \sin k_0 x\, \mathrm{d}x = 0\,.$$

If $h(t, x)$ has continuous derivative of the third order this condition becomes sufficient, too, and then there exist infinitely many ω-periodic solutions of (3.6) and (3.1).

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