with boundary conditions

(14) $$u(t, 0) = u(t, 1) = u_{xx}(t, 0) = u_{xx}(t, 1) = 0 \quad (t \in [0, \omega]),$$

where $a > 0$ and $b \geqq 0$.

Solutions of (13), (14) may be defined as solutions of an equation of the form (1) where we set $H_0 = L_2(J)$, $D(A) = W_2^2(J) \cap \mathring{W}_2^1(J)$, $Au = -u_{xx}$, $F(t, u, v) = -av - b|A^{1/2}u|_0^2 Au + h(t)$ $(h(t)(x) = f(t, x)$ for $x \in J)$. If $h \in C(J; H_0)$ then it is easy to see that F satisfies the assumptions (4) and (6). To verify the assumption (5) we put $G(u) = b|A^{1/2}u|_0^2 Au$, $g(u) = 2^{-1}b|A^{1/2}u|_0^4$, $d = 0$. Then it is easy to see that (5a), (5b), (5c) and (5d) are satisfied. Moreover, $g(u) - (G(u), u)_0 \leqq 0$ for $u \in H_1$. Let c be such that $|u|_0 \leqq c|u|_1$ for $u \in H_1$. Further, let β_0 be a real number satisfying $0 < \beta_0 < 2^{-1}a$, $-2 + (2a - 4\beta_0)^{-1}(a - \beta_0)^2 c^2\beta_0 + 2c^2\beta_0^2 < 0$. Define $p(r) = 2|h| r^{1/2} + ((2a - 4\beta_0)^{-1}(a - \beta_0)^2 c^2\beta_0^2 + 2c^2\beta_0^3) r$ $(r \in [0, \infty))$, where $|h|$ denotes the norm of h in $C(J; H_0)$. Then (5e) and (5f) are satisfied and (5g) also if we take r_0 sufficiently large. Theorem gives now the existence of an ω-periodic solution of (13), (14) for any right hand side f for which $h \in C(J; H_0)$.

Bibliography

[1] *Dunford N., Schwartz J. T.:* Linear operators I. (Interscience Publishers New York—London 1958.)

[2] *Yosida K.:* Functional analysis (Springer-Verlag Berlin—Heidelberg—New York 1971).

[3] *Masuda K.:* On the existence of periodic solutions of nonlinear differential equations (J. Pac. Sci. Univ. Tokyo *12* (1966), 247—257).

[4] *Biroli M.:* Sur l'équation des ondes avec un terme nonlinéaire, monotone dans la fonction inconnue (Atti Accad. Naz. Lincei Rend. Cl. Sci. Fis. Mat. Nat. Serie VIII, vol. *LIII* (1972), 359—361, 508—515).

[5] *Ball J. M.:* Stability theory of an extensible beam (Journ. Diff. Eq. 14 (1973), 399—418).

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