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ON A SPECIAL INTEGRAL EQUATION[1]

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1. **Introduction.** R. H. Cameron posed the following question[2] in a paper [1]. Does

$$y(t) = x(t) + \int_0^t [x(s)]^2 ds, \qquad 0 \leqq t \leqq 1, \tag{1.1}$$

have a solution $x \in C$ for almost every choice of $y \in C$? Here C denotes the space of continuous functions on $0 \leqq t \leqq 1$ which vanish at $t=0$, and "almost every" means all but a set of Wiener measure[3] zero. The answer is no as we proceed to show.

2. We will show that if $y \in N = \{y \in C: |y(t)+4t| < 1/10, 0 \leqq t \leqq 1\}$ then (1.1) has no solution x among the elements of C. Then the answer to the question is no, since N, a uniform neighborhood, has positive measure.

Suppose that $y \in N$, $x \in C$, and (1.1) holds. Let

$$Z(t) = \begin{cases} 0, \ 0 \leqq t \leqq 1/10 \\ -4(t - 1/10), \ 1/10 \leqq t \leqq \pi/4 + 1/10 \end{cases}$$

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[2] This question has two other formulations found in [1].

[3] See, for instance [2].

$$W(t) = \begin{cases} 0, \ 0 \leqq t \leqq 1/10 \\ -2 \tan 2(t - 1/10), \ 1/10 \leqq t < \pi/4 + 1/10 \end{cases}$$

$$E = \left\{t : x(t) \geqq W(t), \ 1/10 \leqq t < \pi/4 + 1/10\right\}$$

and $t_1 = \inf E$. It is easy to see that

$$1/10 < t_1 < \pi/4 + 1/10,$$

$$[x(t)]^2 \geqq [W(t)]^2, \qquad 0 \leqq t < t_1,$$

and

$$x(t_1) = W(t_1).$$

Since

$$Z(t) - \frac{3}{10} > y(t), \qquad \frac{1}{10} \leqq t < \frac{\pi}{4} + \frac{1}{10},$$

and

$$Z(t) = W(t) + \int_0^t [W(s)]^2 ds, \qquad 0 \leqq t < \pi/4 + 1/10$$

we have using (1.1)

$$x(t) = y(t) - \int_0^t [x(s)]^2 ds < Z(t) - \frac{3}{10} - \int_0^t [W(s)]^2 ds = W(t) - \frac{3}{10}$$

for $1/10 \leqq t < t_1$. This is a contradiction since $x(t_1) = W(t_1)$.

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