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For the Hartley oscillator, the conditions of oscillation are:

$$W = \frac{1}{\sqrt{C(L_1 + L_2)}}, \quad \frac{g_m}{\frac{1}{R} + \frac{1}{r_o}} = \frac{L_2}{L_1}$$

$$\therefore C = 1 \mu\text{F}, \quad R = 1 \text{ k}\Omega, \quad L_1 = L_2 = L, \quad f_0 = 20 \text{ kHz}$$

$$\therefore 2\pi \cdot 20 \text{ K} = \frac{1}{\sqrt{1 \mu \cdot 2L}} \Rightarrow L = \frac{1}{3200\pi^2} \simeq \boxed{31.7 \text{ }\mu\text{H}}$$

$$g_m = \frac{L_2}{L_1} \left(\frac{1}{R} + \frac{1}{r_o} \right) = \frac{1}{R} + \frac{1}{r_o} \leq \frac{1}{R} = 10^{-3} \Omega^{-1}$$

$$\Rightarrow \text{The smallest } g_m = \boxed{10^{-3} \Omega^{-1}}$$