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Electrical Engineering

1) From $dy/dt = y_{in} - y_{out}$

$dy/dt = 50(1+\sin t) - 2.5\%$ of y

$y_{out} = \frac{30}{1200} = 0.025$

$y_{out} = 2.5\%$ of $y = \frac{1}{40}y$

$dy/dt = 50(1+\sin t) - 0.025y$

$\frac{dy}{dt} + 0.025y = 50(1+\sin t)$

$1 + 0.025y\,dy = 50(1+\sin t)\,dt$

1b) $\frac{dy}{dt} = 50(1+\sin t) - 0.025y$

$\frac{dy}{dt} + 0.025y = 50(1+\sin t)$

$\frac{dy}{dx} + Py = Q$

$P = 0.025$, $Q = 50(1+\sin t)$

$\therefore \int P.dt = 0.025t$

$I.F = e^{\int P.dt}$

$I.F = e^{0.025t}$

$y.e^{0.025t} = \int 50(1+\sin t)e^{0.025t}.dt$

$y.e^{0.025t} = 50\int(1+\sin t)\,e^{0.025t}\,dt$

$y.e^{0.025t} = 50\int e^{0.025t} + e^{0.025t}\sin t.dt$

$y.e^{0.025t} = 50\frac{e^{0.025t}}{0.025} + \int e^{0.025t}\sin t.dt$

$\int e^{0.025t}\sin t.dt$

$U = e^{0.025t}$ $\quad dv = \sin t$

$du = 0.025e^{0.025t}$ $\quad V = -\cos t$

$\int e^{0.025t}\sin t = e^{0.025t} - \cos t - \int -\cos t.\,0.025e^{0.025t} + C$

$\int e^{0.025t}\sin t = -e^{0.025t}\cos t + 0.025\int e^{0.025t}\cos t + C$

$U = e^{0.025t}$ $\quad dv = \cos t$

$du = 0.025e^{0.025}$ $\quad v = \sin t$

$-e^{0.025t}\cos t$

$-e^{0.025t}\cos t$

Let

$Q = -e^{0.025t}$

$Q = -e^{0.025t}$

$Q + 6.25$

1.00062

$Q = \frac{-}{1}$

$y = 200$

$150 = 2$

$150 = 2$

150

$Q =$

$\int e$

$= -e^{0.025t}\cos t + 0.025\left[e^{0.025t}\sin t - \int \sin t \cdot 0.025 e^{0.025t}\right]$

$= -e^{0.025t}\cos t + 0.025\left[e^{0.025t}\sin t - 0.025\int \sin t\, e^{0.025t}\right]$

Let $Q = \int e^{0.025t}\sin t$

$Q = -e^{0.025t}\cos t + 0.025\left[e^{0.025t}\sin t - 0.025Q\right]$

$Q = -e^{0.025t}\cos t + 0.025e^{0.025t} - 0.25^{4}Q$

$Q + 6.25^{4}Q = -e^{0.025t}\cos t + 0.025e^{0.025t}$

$1.000627Q = -e^{0.025t}(\cos t - 0.025)$

$Q = \frac{-e^{0.025t}}{1.000625}(\cos t - 0.025) + C$

$y = 2000 - \frac{50}{1.000625}(\cos t - 0.025\sin t) + \frac{50C}{e^{0.025t}}$

when $y = 150$, $t = 0$

$150 = 2000 - \frac{50}{1.000625}(\cos 0 - 0.025\sin 0) + \frac{50C}{e^{0.025(0)}}$

$150 = 2000 - 49.968(1) + 50C$

$150 = 1950.032 + 50$

$\frac{50C}{50} = \frac{-1800.032}{50}$

$C = \pm 36.00064$

$Q = \frac{-e^{0.025t}}{1.000625}(\cos t - 0.025) + C$

$\int e^{0.025t}\sin t = \frac{-e^{0.025t}}{1.000625}(\cos t - 0.025) + C$

$y \cdot e^{0.025t} = 50\left[\frac{e^{0.025t}}{0.025} - \frac{e^{0.025t}}{1.000625}(\cos t - 0.025) + C\right]$

$y \cdot e^{0.025t} = 2000e^{0.025t} - 50 \cdot \frac{e^{0.025t}}{1.000625}(\cos t - 0.025) + 50C$

$y = 2000 - \frac{50}{1.000625}(\cos t - 0.025) + \frac{50C}{e^{0.025t}}$