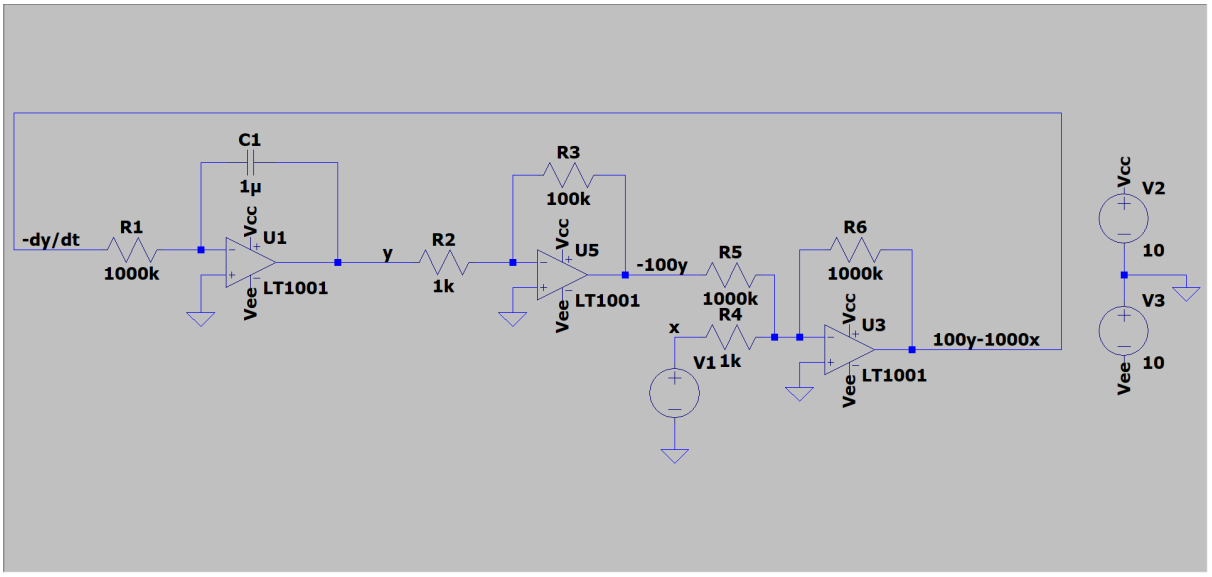
Design Challenge -1 (Differential equation solver)

Software used: LTspice

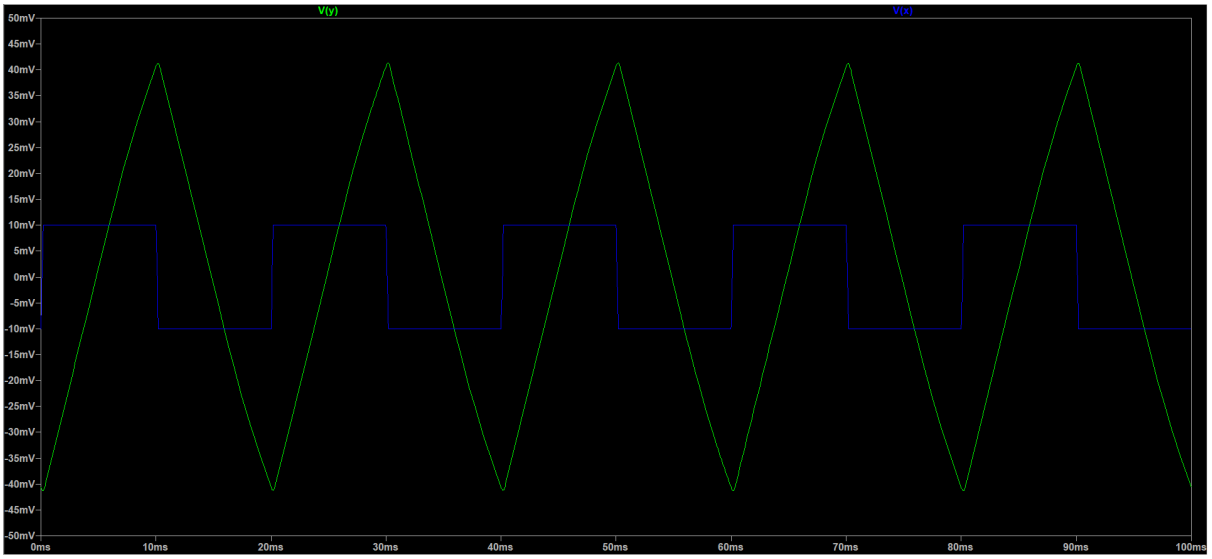
For the following differential equation:

$$\frac{dy(t)}{dt} + ay(t) = 1000x(t)$$ with a = 100

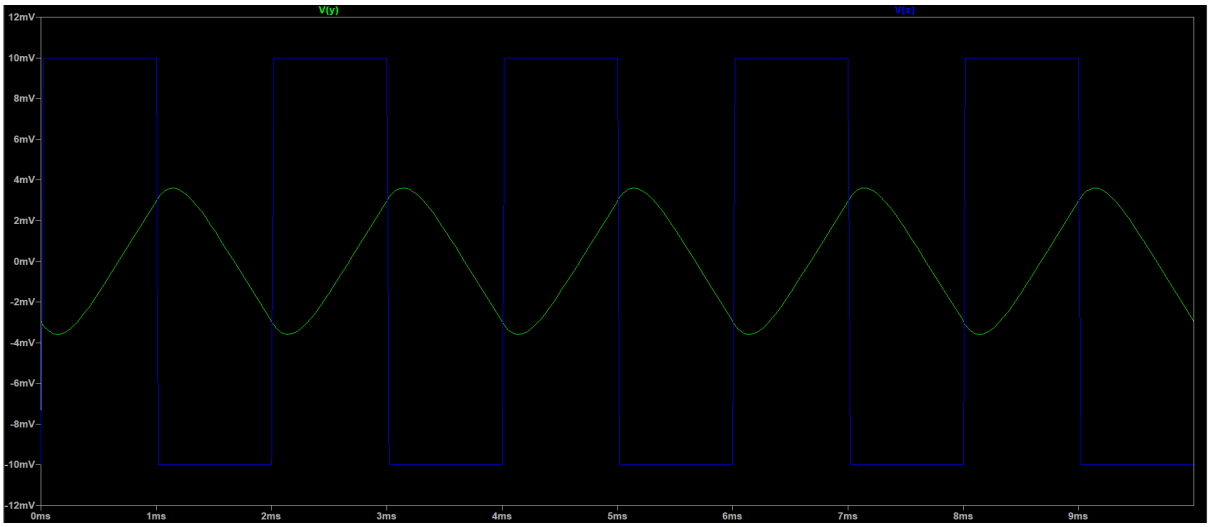
Circuit:



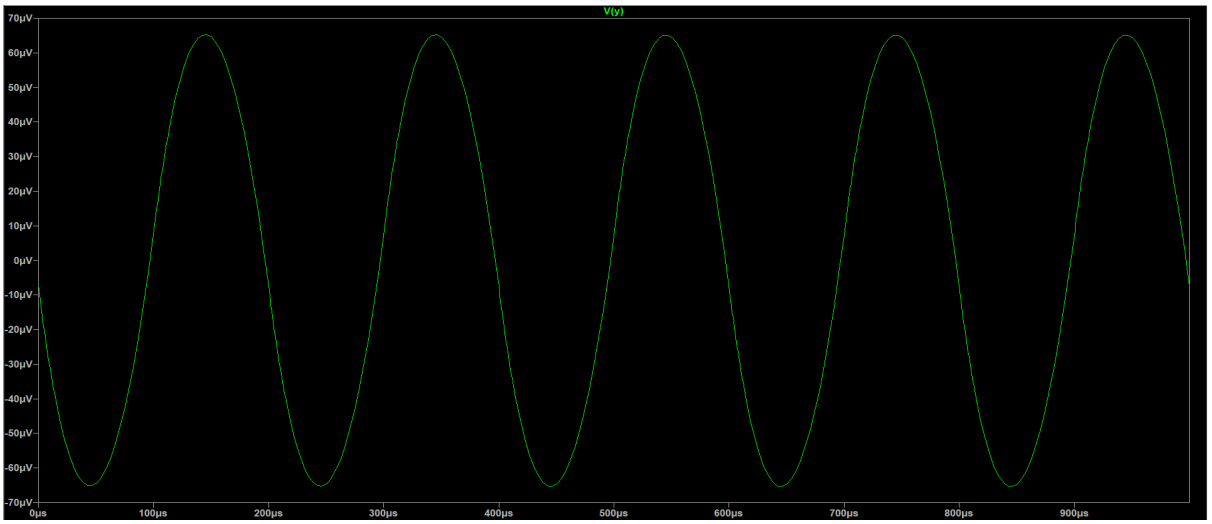
1. y(t) observed on the scope when x(t) = **a square wave of frequency 50Hz** with amplitude 10mV



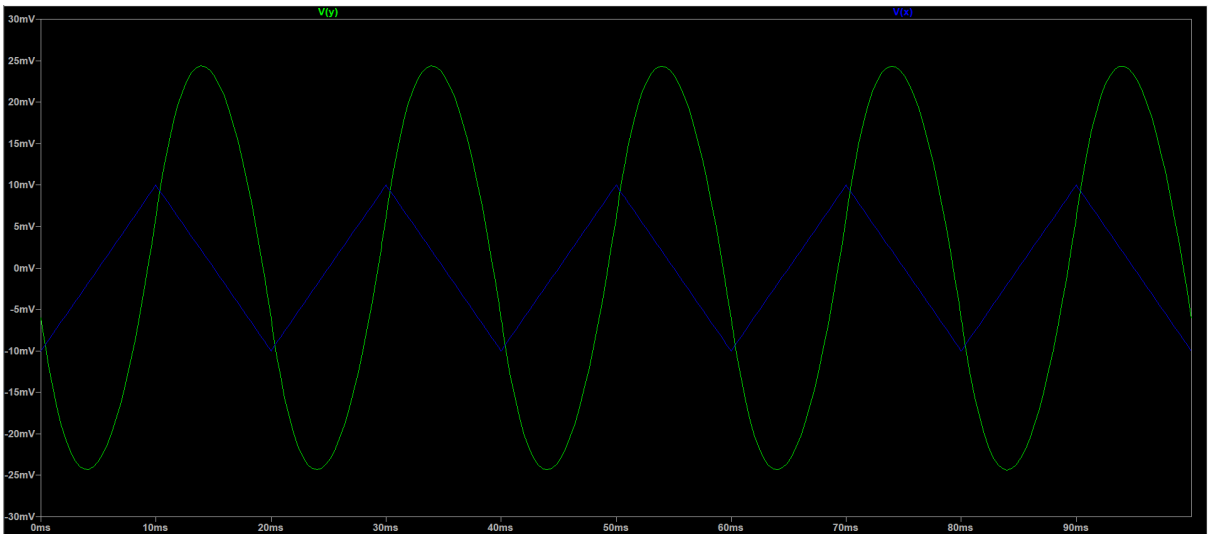
2. y(t) observed on the scope when x(t) = **a square wave of frequency 500Hz** with amplitude 10mV



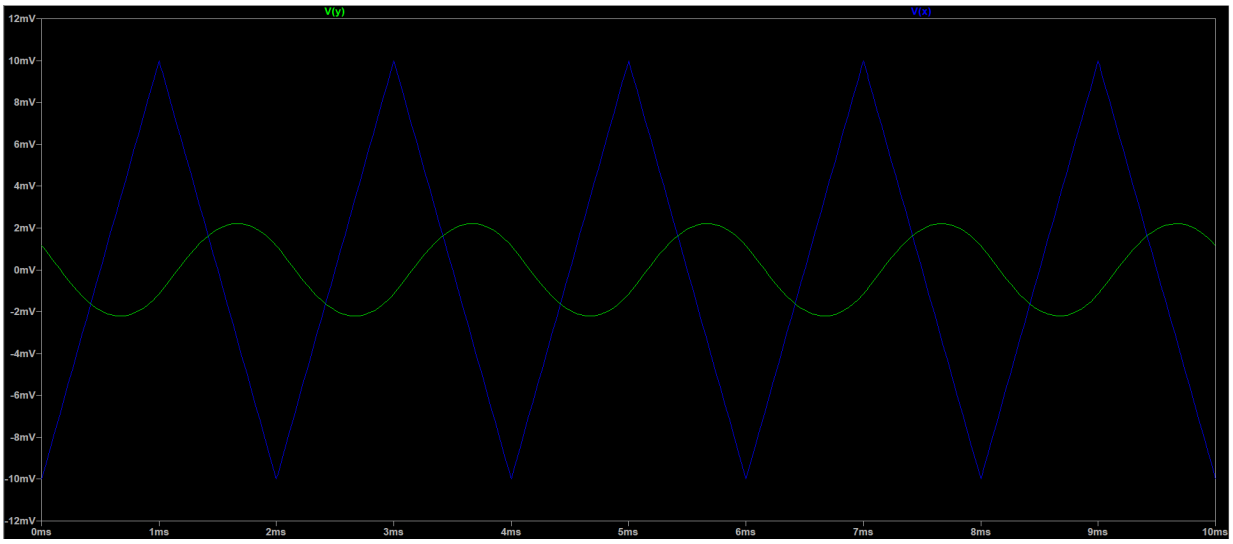
3. y(t) observed on the scope when x(t) = **a square wave of frequency 5kHz** with amplitude 10mV



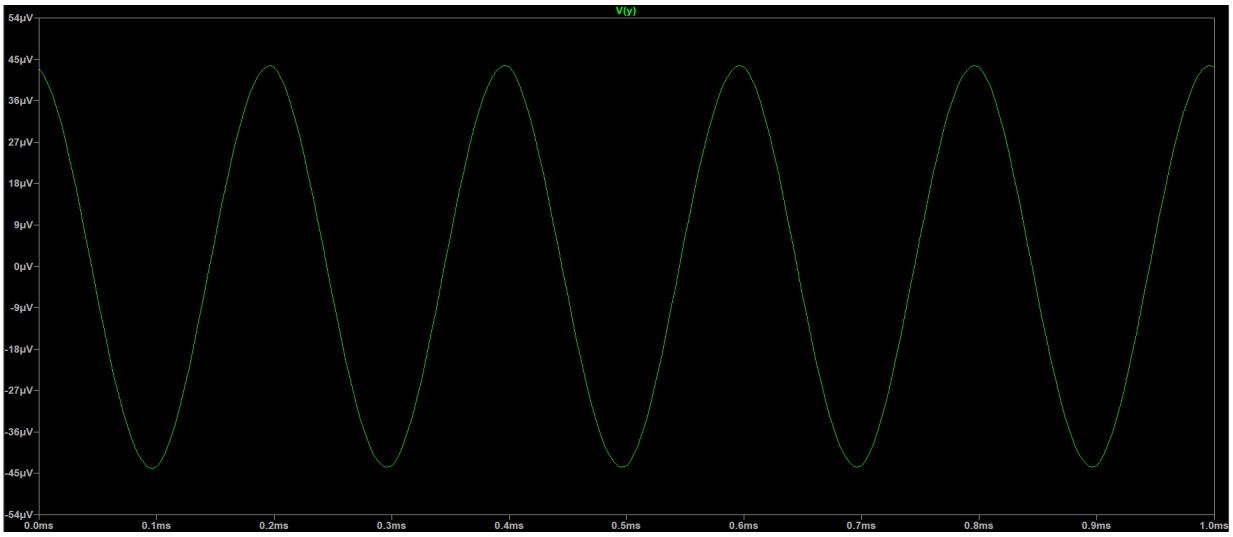
4. y(t) observed on the scope when x(t) = **a triangular wave of frequency 50Hz** with amplitude 10mV



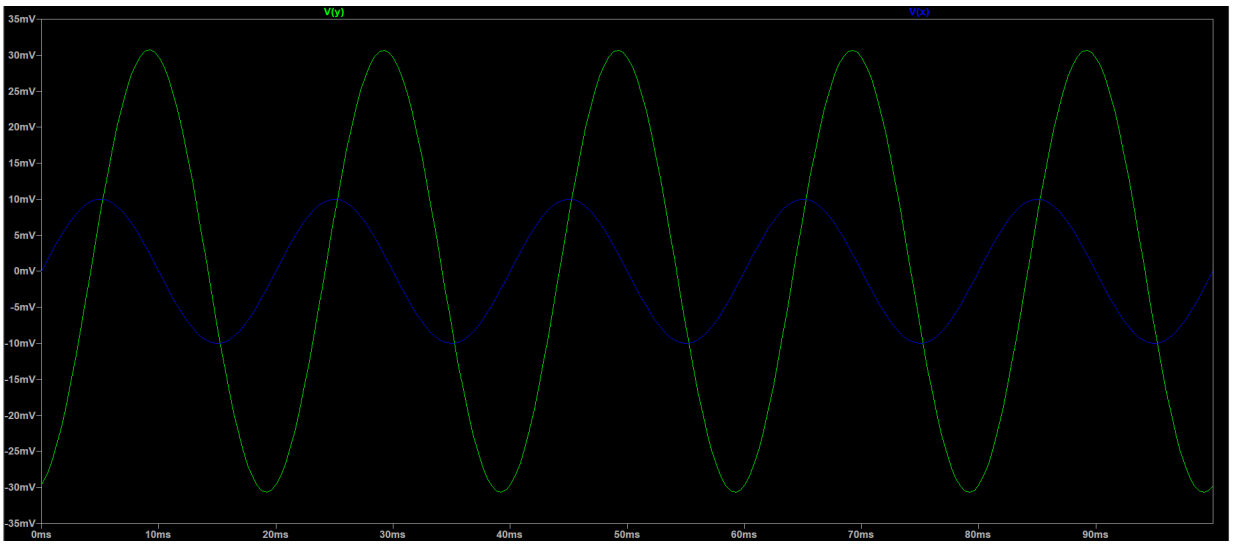
5. y(t) observed on the scope when x(t) = **a triangular wave of frequency 500Hz** with amplitude 10mV



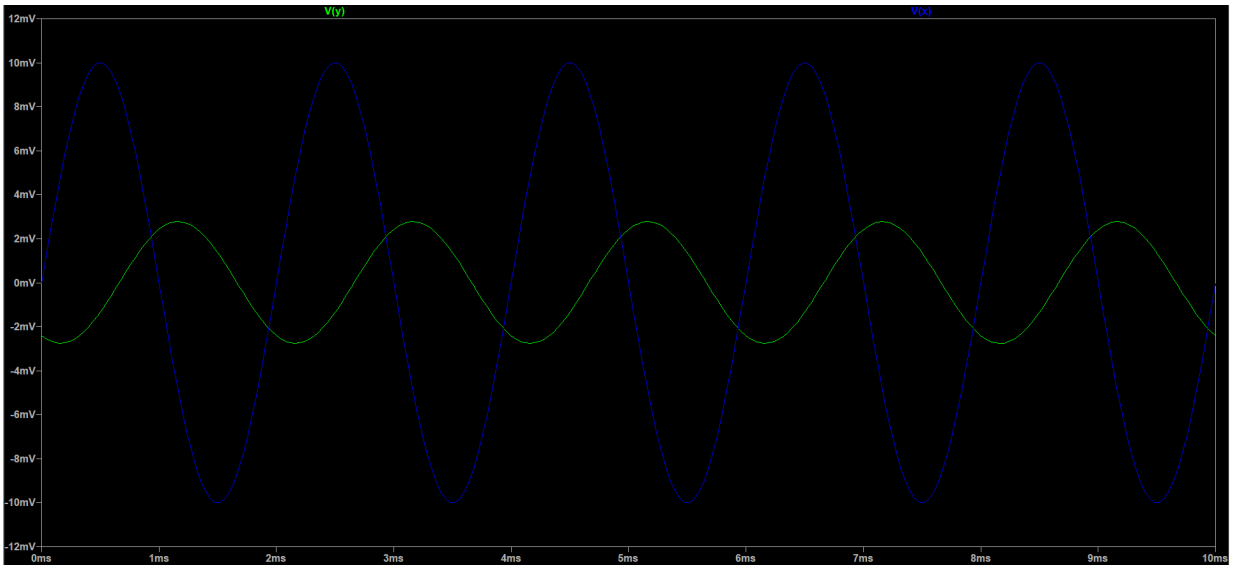
6. y(t) observed on the scope when x(t) = **a triangular wave of frequency 5kHz** with amplitude 10mV



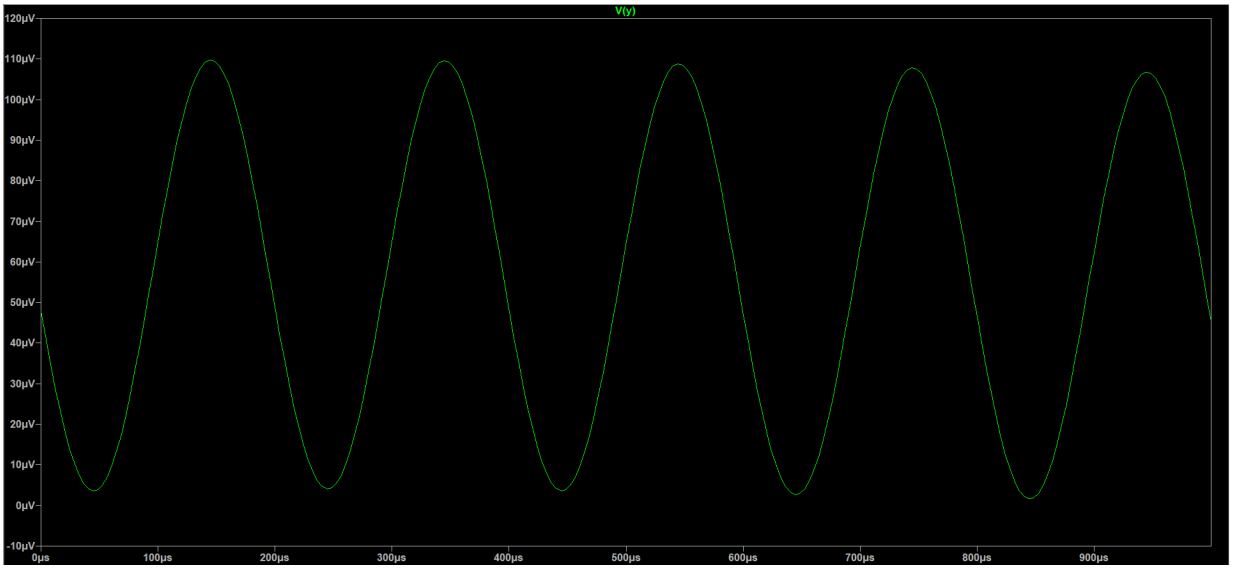
7. y(t) observed on the scope when x(t) = **a sine wave of frequency 50Hz** with amplitude 10mV



8. y(t) observed on the scope when x(t) = **a sine wave of frequency 500Hz** with amplitude 10mV



9. y(t) observed on the scope when x(t) = **a sine wave of frequency 5kHz** with amplitude 10mV

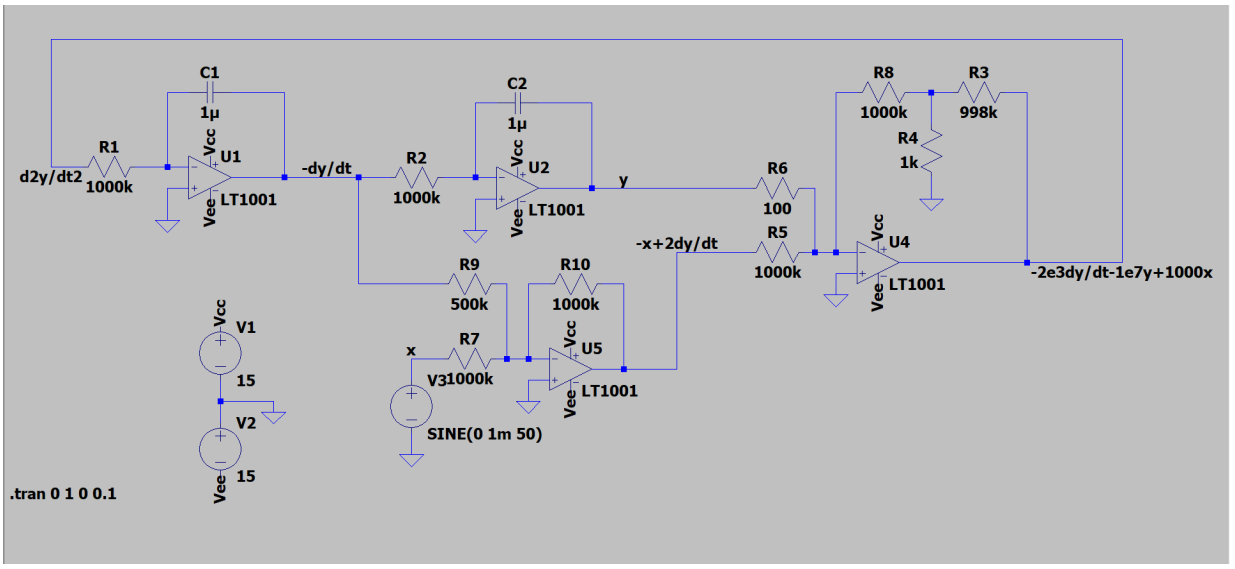


For the following differential equation:

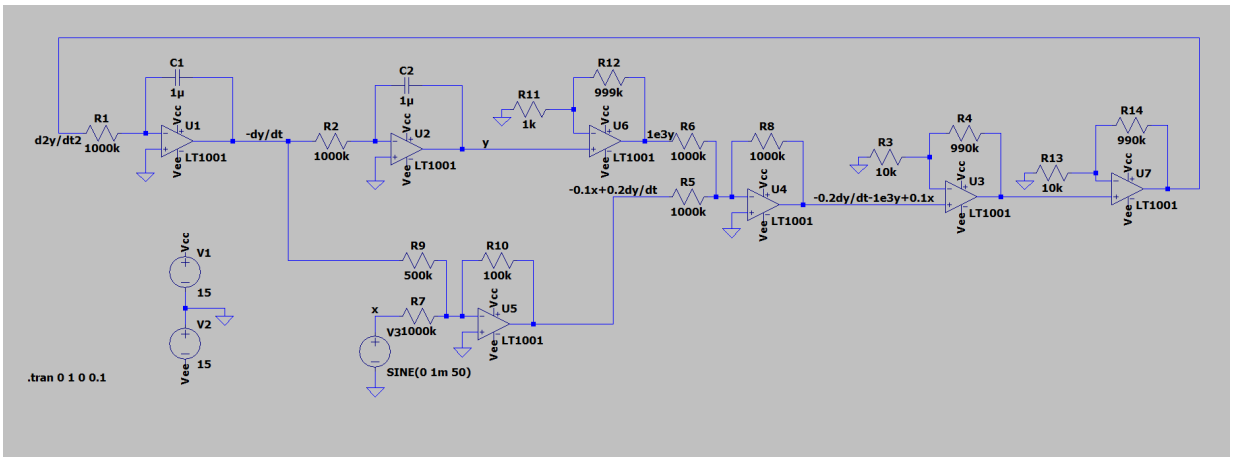
$$\frac{d^2y(t)}{dt^2} + a\frac{dy(t)}{dt} + by(t) = 1000x(t)$$ with a = 2e3, b = 1e7

Circuit:

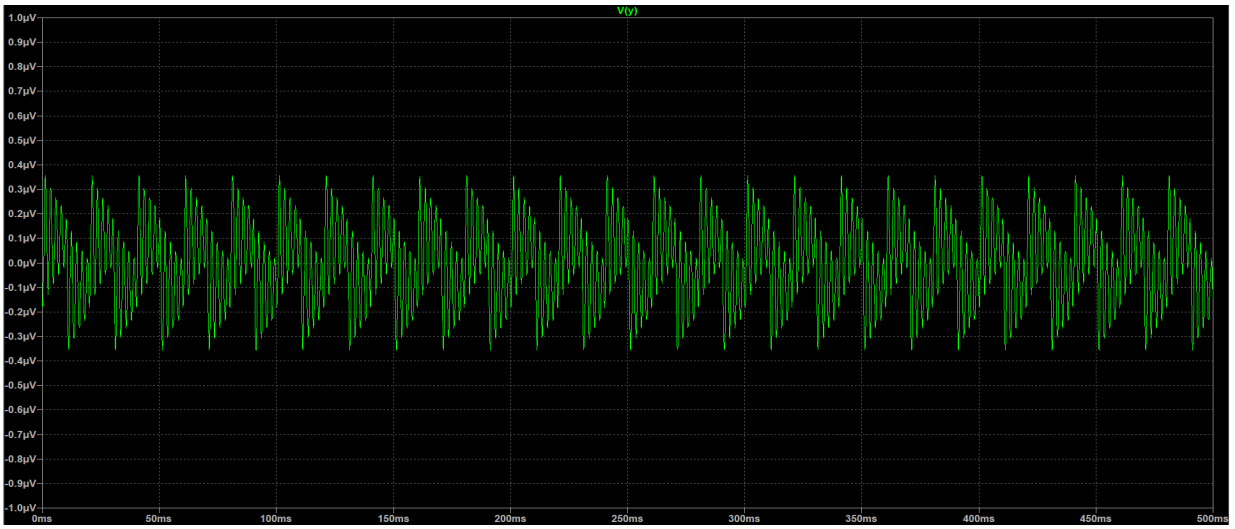
Ideal circuit with minimum op amps is as follows:



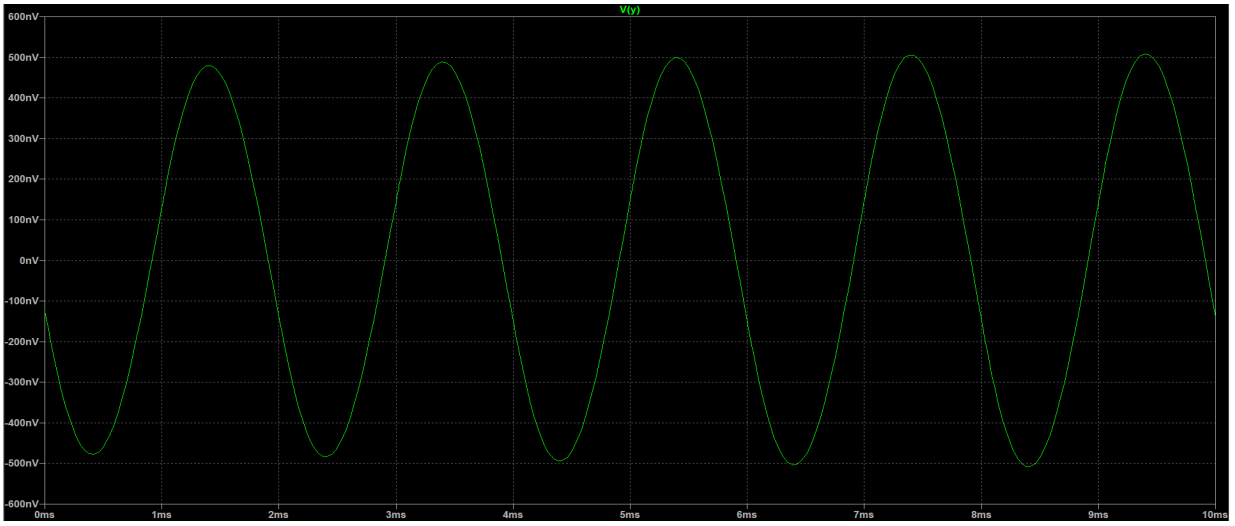
Following is the circuit such that the bias currents and offset voltages will not affect much on the outputs of op amp as closed loop gains of each op amp is less:



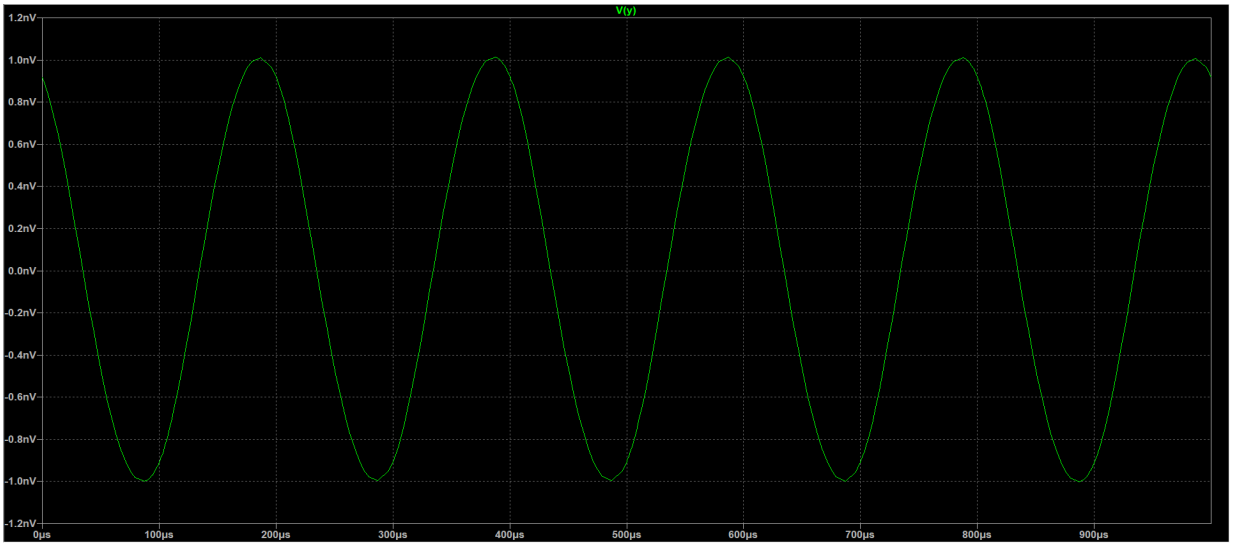
1. y(t) observed on the scope when x(t) = **a square wave of frequency 50Hz** with amplitude 1mV



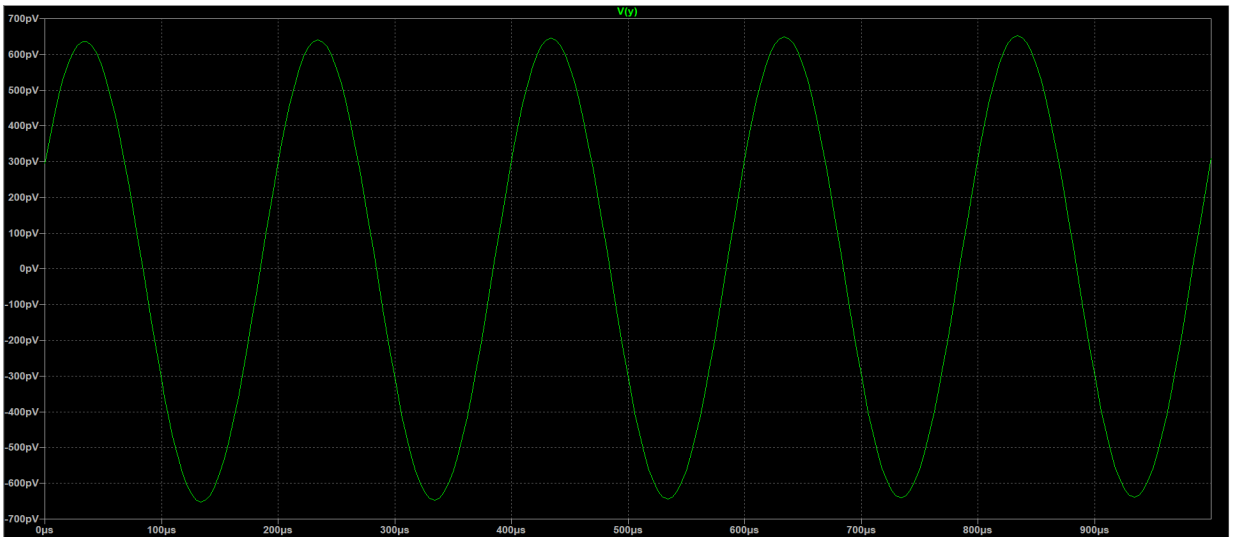
2. y(t) observed on the scope when x(t) = **a square wave of frequency 500Hz** with amplitude 1mV



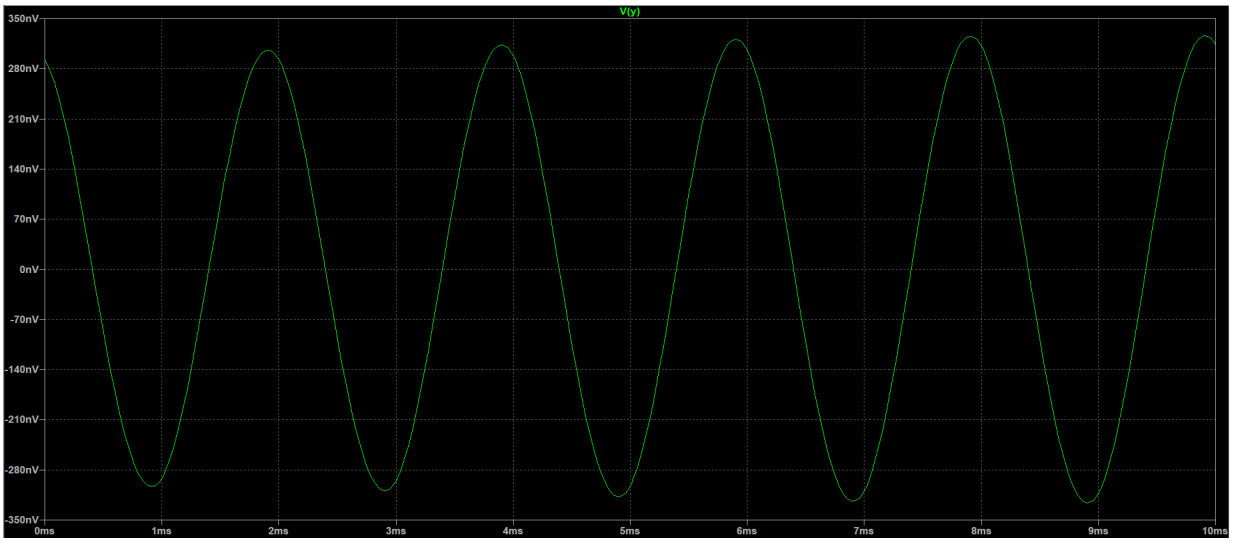
3. y(t) observed on the scope when x(t) = **a square wave of frequency 5kHz** with amplitude 1mV



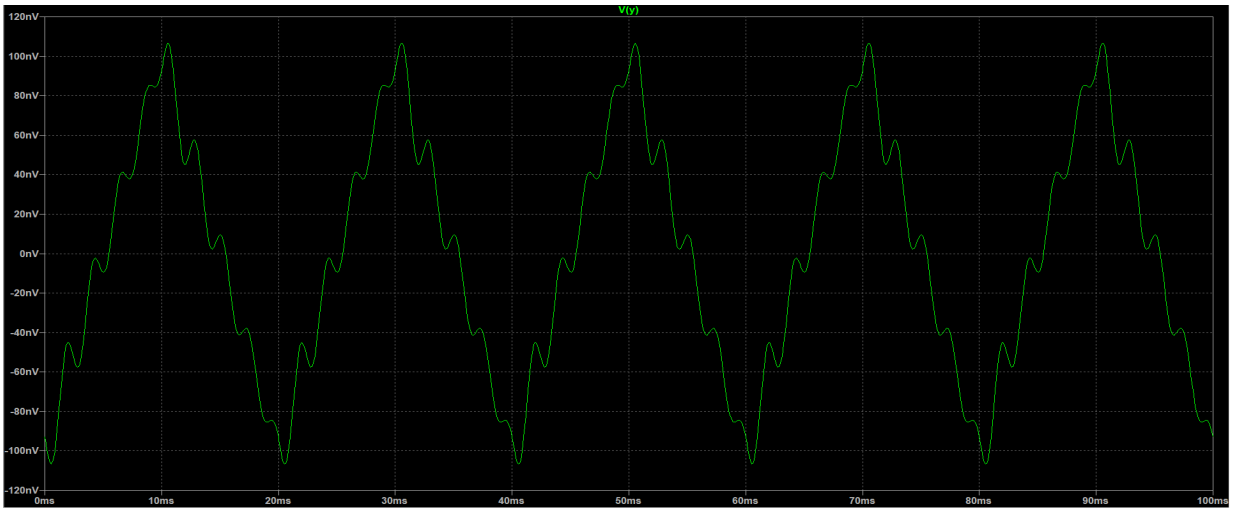
4. y(t) observed on the scope when x(t) = **a triangular wave of frequency 50Hz** with amplitude 1mV



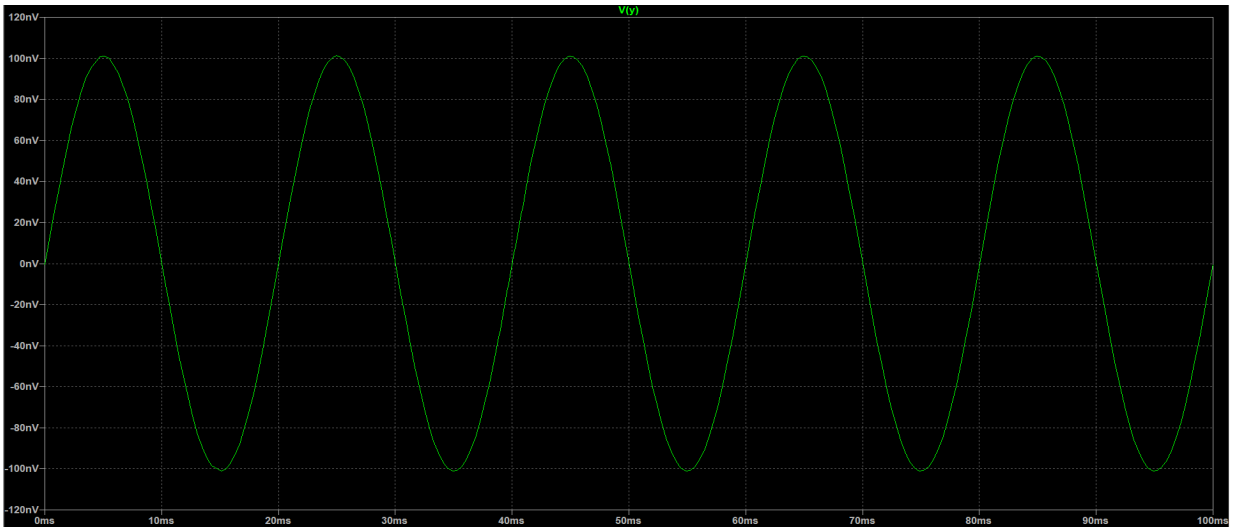
5. y(t) observed on the scope when x(t) = **a triangular wave of frequency 500Hz** with amplitude 1mV



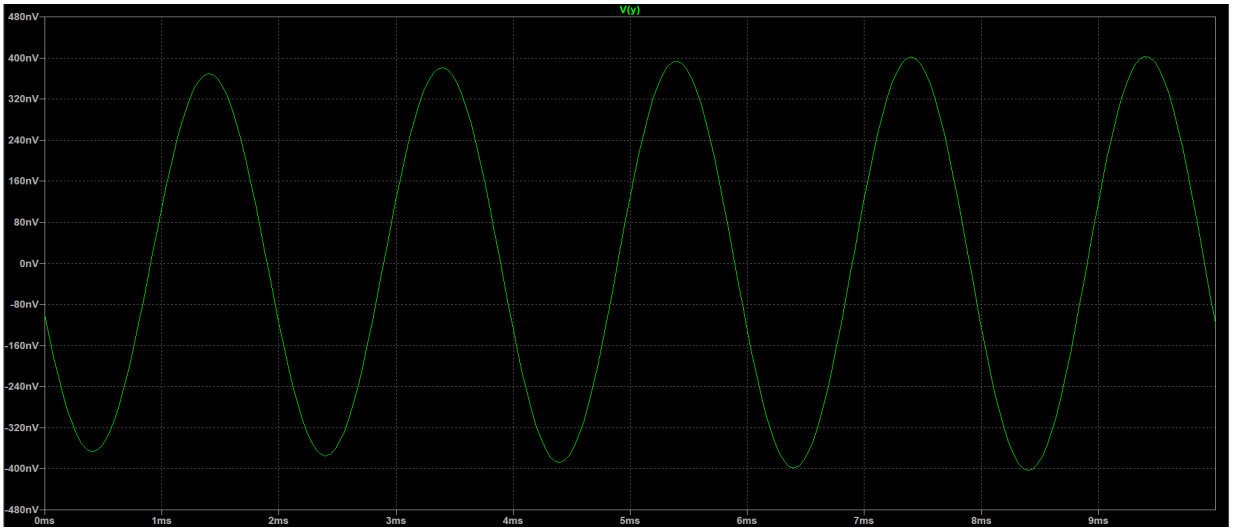
6. y(t) observed on the scope when x(t) = **a triangular wave of frequency 5kHz** with amplitude 1mV



7. y(t) observed on the scope when x(t) = **a sine wave of frequency 50Hz** with amplitude 1mV



8. y(t) observed on the scope when x(t) = **a sine wave of frequency 500Hz** with amplitude 1mV



9. y(t) observed on the scope when x(t) = **a sine wave of frequency 5kHz** with amplitude 1mV