Group 1: RC-Circuit with Voltage Source.

$$RC\frac{dV}{dt} + V = V_s \quad ; \quad V(t=0) = 0$$

V(t) is the unknown function. R (resistor), C (Capacitor) , and V_s (Voltage source) are all known constants.

Group 2: RC-Circuit.

$$RC\frac{dV}{dt} + V = 0 \quad ; \quad V(t=0) = V_0$$

V(t) is the unknown function. R (resistor), C (Capacitor) , and V_0 (Initial Voltage) are all known constants.

Group 3: RL-Circuit with Voltage Source.

$$L\frac{dI}{dt} + RI = V_s \quad ; \quad I(t=0) = 0$$

I(t) is the unknown function. R (resistor), L (Inductor) , and V_s (Voltage source) are all known constants.

Group 4: RL-Circuit.

$$L\frac{dI}{dt} + RI = 0; \quad I(t=0) = I_0$$

I(t) is the unknown function. R (resistor), L (Inductor) , and I_0 (Initial current) are all known constants.

Group 5: Non linear RC Circuit. (Desoer and Kuh, pp116-117)

(where $I_R = V_R^3$, and assume C=1F)

$$C\frac{dV}{dt} + V^3 = 0 \quad ; \quad V(t=0) = 0$$

Group 6: Mass Moving on a Plane with Friction.

$$M\frac{dv}{dt} = -Bv \quad ; \quad v(t=0) = v_0$$

M – known mass ; B – Known friction coefficient ; $v(t)$ – unknown function to be determined.

Group 7: Population Growth Models.

$$\frac{dN}{dt} = kN\left(N_{equi} - N\right) \quad ; \quad N(t=0) = N_0$$

$N(t)$ is the population number, to be solved for. K, N_{equi} , and N_0 are known constants.

Group 8: Radioactive Decay.

$$\frac{dm}{dt} = -km \quad ; \quad m(t=0) = m_0$$

$m(t)$ is the mass to be solved for. k and m_0 are known constants.