Circuits and systems II , Tutorial No 4

1. Transform state-space description into 1 differential equation of nth order

A) $\dot{X} = \begin{bmatrix} -1 & 2 \\ 4 & -5 \end{bmatrix} X + \begin{bmatrix} 7 \\ 9 \end{bmatrix} u$

B) $\dot{X} = \begin{bmatrix} -2 & 1 & 0 \\ -1 & -1 & 2 \\ -3 & 4 & -3 \end{bmatrix} X$

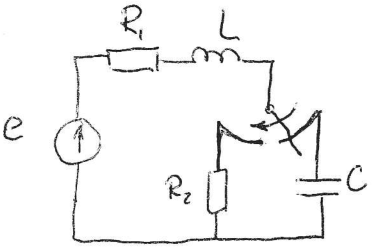
2. Transform one equation of nth order into state space descriptio

a) $\frac{d^2x}{dt^2} + 2\frac{dv}{dt} + 3x = 3e_1$ Hints: $x_1 = x$, $x_2 = \frac{dx_1}{dt}$

b) $\frac{d^3x}{dt^3} + 4\frac{d^2x}{dt} + 3\frac{dx}{dt} + 7x = e_1 + 2e_2$ Hints. $x_1 = x$, $x_2 = \frac{dx_1}{dt}$, $x_3 = \frac{dx_2}{dt}$

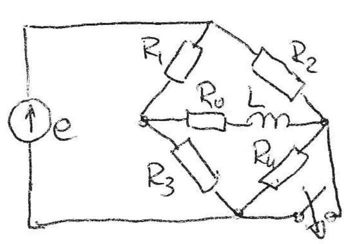
3. Determine $u_c(t)$, $i_L(t)$ in transient state after switching (classical method)

a)



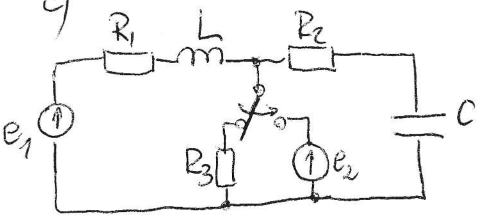
$e(t) = 20\sin(t + 45°)$
$R_1 = 1\Omega$, $R_2 = 9\Omega$
$L = 2H$, $C = 1F$

b)



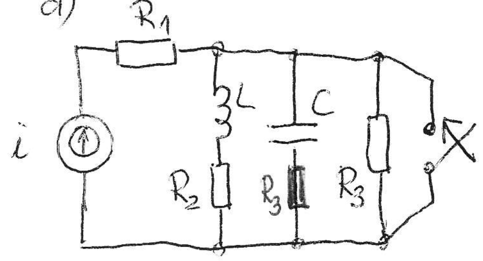
$e(t) = 10\sqrt{2}\sin t$
$R_1 = 4\Omega$, $R_2 = 2\Omega$ $R_0 = 3\Omega$
$R_3 = 10\Omega$ $R_4 = 5\Omega$ $L = 2H$

c)



$R_1 = 2\Omega$, $R_2 = R_3 = 1\Omega$
$L = 2H$, $C = 1F$
$e_1(t) = 20\sqrt{2}\sin t$
$e_2(t) = 40\sqrt{2}\sin(t + 90°)$

d)



$R_1 = 10\Omega$ $L = 1H$
$R_2 = 2\Omega$ $C = 100\mu F$
$R_3 = 4\Omega$
$i(t) = 12A$

4. Calculate inverse Laplace transform of the fuction

a) $F(s) = \frac{s+4}{(s+1)(s+2)}$

b) $F(s) = \frac{3s^2 + 2s}{s^2 + 6s + 8}$

c) $F(s) = \frac{s+1}{s(s+3)^2}$

d) $F(s) = \frac{2s^2 + s + 1}{s^2 + 4s + 10}$

e) $F(s) = \frac{3s + 7}{s^2 + 2s + 5}$

f) $F(s) = \frac{3s^2 + 2s + 1}{s^2 + 6s + 10}$