Discrete and Continuous Dynamical Systems

Tutorial, 2018.02.14.

1. (a) Calculate the eigenvalues and eigenvectors of the following matrices!

$$\boldsymbol{G} = \begin{bmatrix} 3 & 0 \\ 0 & -2 \end{bmatrix}$$

$$\boldsymbol{H} = \begin{bmatrix} 2 & 1 \\ 0 & 1 \end{bmatrix}$$

   (b) Calculate the following quantities!

$$\det(\boldsymbol{H}),\ \det(\boldsymbol{G}),\ \operatorname{Tr}\boldsymbol{H},\ \boldsymbol{G}^{-1},\ \boldsymbol{H}^{-1}$$

2. (a) Calculate the following Laplace transforms!

$$\mathcal{L}\left\{3e^{2t} + \delta(t) + \frac{\mathrm{d}4e^{-5t}}{\mathrm{d}t}\right\} =$$

$$\mathcal{L}\left\{\int_0^t e^{-3\tau}\eta(t-\tau)\mathrm{d}\tau\right\} =$$

   (b) Calculate the following inverse Laplace transforms!

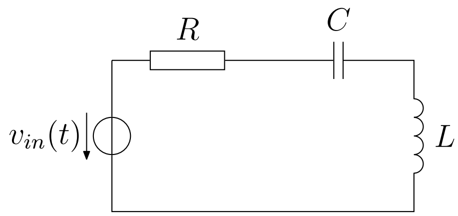
$$\mathcal{L}^{-1}\left\{\frac{2}{s^2+3s}\right\} =$$

$$\mathcal{L}^{-1}\left\{\frac{3s^2+12s+11}{s^3+6s^2+11s+6}\right\} =$$

3. Solve the following initial value problem using Laplace transform!

$$\ddot{y}(t) + \dot{y}(t) - 2y(t) = 4, \quad \dot{y}(0) = 1, \quad y(0) = 2$$

4. **Homework:** Given the following electrical network. The task is to determine inductors current for $t \geq 0$!



$$v_{in}(t) = \begin{cases} 0\,\mathrm{V}, & t < 0 \\ 1\,\mathrm{V}, & t \geq 0 \end{cases}$$

Matrix form: $\boldsymbol{x}(t) = \begin{bmatrix} i_L(t) & v_C(t) \end{bmatrix}^T$, $y(t) = i_L(t)$, $u(t) = v_{in}(t)$

(a) How many inputs and outputs does your system have?

(b) Which basic system properties hold for your system?

(c) From the basic equations of motion given, express your system in state space form! Substitute your parameter values (R, L, C) into the obtained parametric model!

Deadline of submission: 2018.02.21. 8am
(Submit your homework in the moodle course in a hand written scanned pdf format! Please, write your name and neptun ID on the paper!)