

Matlab Mock Exam

(1)

(1) $A \rightarrow 3 \times 3$, $B \rightarrow 3 \times 2$, $C \rightarrow 2 \times 3$

\downarrow
order = 3

\downarrow
of inputs = 2

\downarrow
of outputs = 2

~~The ^{rank of} ctrb matrix is~~

(2) The rank of the CTRB matrix is $3 = n$, so sys is CTRB.

(3) ~~the~~ $A = \begin{bmatrix} -1 & 0 & 0 & 0 & -1 \\ 0 & -1 & -1 \end{bmatrix}$

$$B = \begin{bmatrix} 1 & 0 & 1 \\ -1 & 2 \end{bmatrix}$$

$$C = \begin{bmatrix} 1 & 1 & 0 \\ 0 & 1 & -1 \end{bmatrix}$$

$$O = \text{obsv}(A, B) \quad \downarrow$$

$$\text{rank}(O) \quad \downarrow$$

$$= 3 \quad \square$$

As the rank of the obsv matrix equals the order of the sys, the sys is OBSV.

$$(4) [num, den] = ss2tf(A, B, C, zeros(2), 1) \quad (9)$$

$$num = \begin{matrix} 0 & 1 & 1 & 1 \\ 0 & 1 & 1 & 0 \end{matrix}$$

$$den = 1 \quad 3 \quad 4 \quad 2$$

$$so \quad G_{1,1} = \frac{s^2 + s + 1}{s^3 + 3s^2 + 4s + 2}$$

$$G_{2,1} = \frac{s^2 + s}{s^3 + 3s^2 + 4s + 2}$$

$$[num, den] = ss2tf(A, B, C, zeros(2), 1) \quad (9)$$

$$num = \begin{matrix} 2 & 6 & 5 \\ -1 & 1 & 2 \end{matrix}$$

$$den = 1 \quad 3 \quad 4 \quad 2$$

$$G_{1,2} = \frac{2s^2 + 6s + 5}{s^3 + 3s^2 + 4s + 2}$$

$$G_{2,2} = \frac{-s^2 + s + 2}{s^3 + 3s^2 + 4s + 2}$$

5

(clc, clear

syms x1(t), x2(t), x3(t)

$$A = [-1 \ 0 \ 0; \ 0 \ -1 \ 1; \ 0 \ -1 \ -1];$$

$$DX1 = diff(x1);$$

$$DX2 = diff(x2);$$

$$DX3 = diff(x3);$$

$$DX = [DX1; DX2; DX3];$$

$$X = [x1; x2; x3];$$

$$\text{sol} = \text{solve}(DX - A \cdot X, X(0) == [1; 1; 1]);$$

sol.x1

sol.x2

sol.x3

which will return:

$$e^{-t}$$

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

$$+ e^{-t} \cdot \sin t$$

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

$$- e^{-t} \cdot \sin t$$

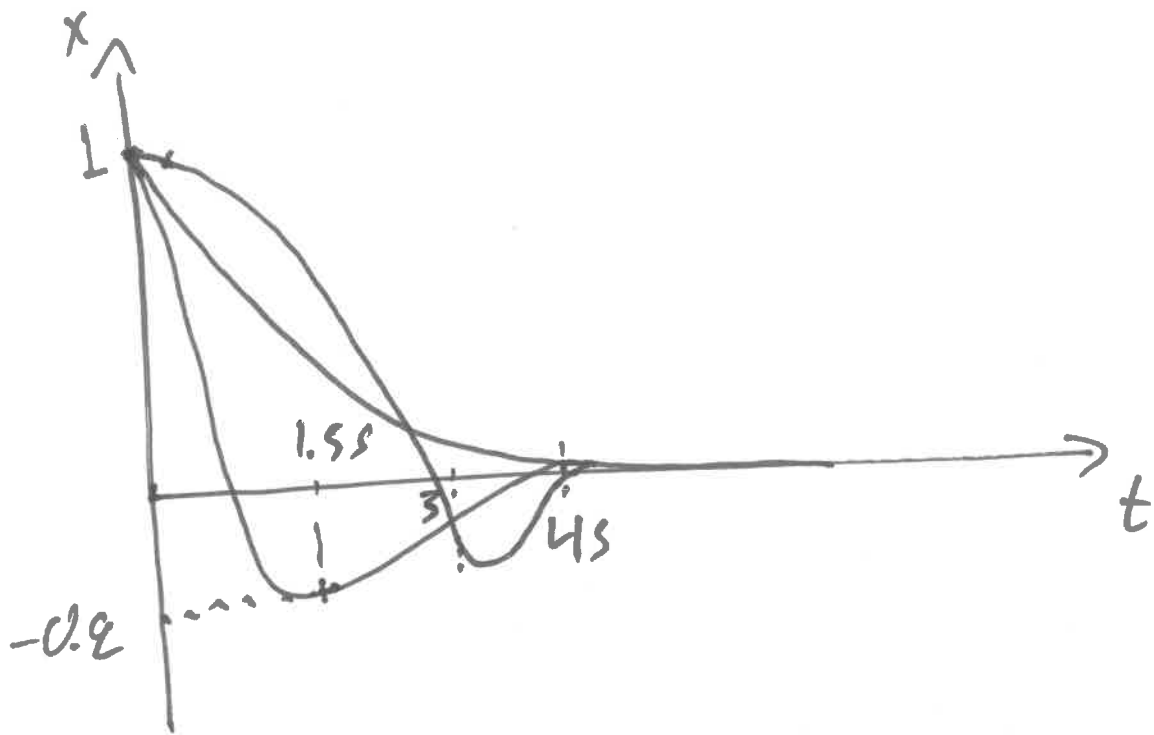
so specific soln:

$$x(t) = \begin{bmatrix} e^{-t} & e^{-t} (\cos t + \sin t) & e^{-t} \begin{bmatrix} \sin t \\ \cos t \end{bmatrix} \end{bmatrix}$$

(6)

From simulation I have

(4)



+ Qualitative comments
like stable, fast, oscillatory...
on ALL results.