

EEM301-01 HOMEWORK

1. Consider the following systems with x as input and y as output;

$$S_1: \frac{d^2 y(t)}{dt^2} + a \frac{dy(t)}{dt} + by(t) = c \frac{dx(t)}{dt} + dx(t)$$

$$S_2: y(n) + ey(n-1) + fy(n-2) = gx(n) + hx(n-1)$$

i	a	b	c	d	i	e	f	g	h
1	3	2	1	1	16	ny	1	2	1
2	1	t	1	1	17	3	2	1	1
3	1	1	1	t	18	1	n	1	1
4	y	1	0	1	19	1	1	1	n
5	1	1	1	x	20	y	1	0	1
6	y	1	0	t	21	1	1	1	x
7	2	1	0	2	22	y	1	0	n
8	2	1	2t	3	23	2	1	0	2
9	2	2y	0	1	24	2	1	2n	3
10	3y	1	1	1	25	2	2y	0	1
11	0	t	2	1	26	3y	1	1	1
12	0	ty	0	1	27	0	n	2	1
13	3	2	x	1	28	0	ny	0	1
14	3	2	t	0	29	3	2	x	1
15	0	0	0	tx	30	3	2	n	0

Mathematically determine whether S_1 or S_2 is a linear/nonlinear and time-invariant/time-varying system for the given coefficients. Note that the index i corresponds to the student's place in the register.

2. Consider the S_1 and S_2 with the following coefficients:

i	a	b	c	d	i	e	f	g	h
1	3	2	1	1	16	-0.4	0.04	1	1
2	2	1	2	1	17	-0.5	0.06	2	1
3	2	2	1	2	18	-1	0.25	1	2
4	5	6	3	2	19	-0.7	0.12	1	0
5	4	4	1	3	20	-0.9	0.2	2	1
6	4	13	1	1	21	-1.2	0.36	2	3
7	7	12	2	1	22	-1.1	0.3	1	2
8	6	9	1	2	23	-1.3	0.42	3	2
9	2	5	2	3	24	-1.4	0.49	1	1
10	9	20	1	2	25	-1.5	0.56	2	1
11	8	16	3	2	26	-1.7	0.72	1	2
12	6	25	1	1	27	-1.5	1.0	1	0
13	11	30	3	2	28	-1.6	1.0	1	1
14	10	25	1	2	29	-1.7	1.0	2	1
15	8	41	1	1	30	-1.8	1.0	1	2

- (a) Find the impulse response $h(t)$ or $h(n)$ of the causal LTI system S_1 or S_2 with the corresponding coefficients given above.
- (b) Obtain the output $y(t)$ or $y(n)$ for the following casual input utilizing either the convolution integral or convolution sum,

$$x(t) = e^{-8t}u(t) \quad \text{or} \quad x(n) = (0.1)^n u(n)$$

Note that Problems 1 and 2 are due on Friday of the 8th week.

3. Consider S_1 with $\{c=0$ and $d=1\}$ or S_2 with $\{g=1$ and $h=0\}$ LTI system and the corresponding $\{a, b\}$ or $\{e, f\}$ coefficients given in Pr. 2 above. Find the Fourier series (FS) representation of the output $y(t)$ or $y(n)$ for the following input:

$$x(t) = \cos 2\pi t \quad \text{or} \quad x(n) = \sin\left(\frac{3\pi}{4}n\right)$$

Note that for the Problem 3, student's new index is taken as

$$16 \leq (i+15) \leq 30 \quad \text{or} \quad 1 \leq (i - 15) \leq 15$$

4. Consider S_1 with $\{c=0$ and $d=1\}$ or S_2 with $\{g=1$ and $h=0\}$ LTI system and the corresponding $\{a, b\}$ or $\{e, f\}$ coefficients given in Pr. 2 above.
- (a) Determine the frequency response $H(j\omega)$ of S_1 or $H(e^{j\omega})$ of S_2 utilizing the Fourier (or DT) Transform.
- (b) Obtain the output response $y(t)$ or $y(n)$ for the following input using FT or DTFT:

$$x(t) = te^{-2t}u(t) \quad \text{or} \quad x(n) = \left(-\frac{1}{2}\right)^n u(n)$$

5. Consider S_1 with $\{c=0$ and $d=1\}$ or S_2 with $\{g=1$ and $h=0\}$ LTI system and the corresponding $\{a, b\}$ or $\{e, f\}$ coefficients given in Pr. 2 above.
- Obtain the output response $y(t)$ or $y(n)$ for the following input using FT or DTFT:

$$x(t) = 5e^{-3t}u(t) \quad \text{or} \quad x(n) = \delta(n) + \frac{1}{2}\delta(n-1)$$

Note that for the Problem 5, student's new index is taken as

$$16 \leq (i+15) \leq 30 \quad \text{or} \quad 1 \leq (i - 15) \leq 15$$

Note that Problems 3, 4 and 5 are due on Friday of the 14th week.

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