Topics

* TF, BD, SFG → 1m or 2M
* TDA
  - → Transient Analysis
  - → Steady State Analysis
  } 2m
* S
  - → Time domian tech ⇒ RH/RL
  - → frequency domain tech ⇒ BP/NP.
  } 4m
* compensators / controllers
* State Space Analysis → 2m

Subject:

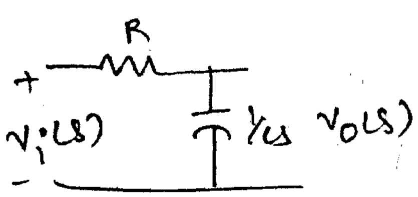
⇒ TF ⇒ mathematical equivalent model for the sym.

$$TF = \frac{1}{S+1}$$

order - 1.

Order represents the no. of Energy storage elements (or) No. of time constants

* Single time constants ckt's are RL, RC.
* Control sym's are basically LPF.



$$\frac{V_o}{V_i} = \frac{1}{SRC+1} = \frac{1}{S\tau+1}$$

* main objective of control sym is Desired output (or) accurate o/p

⇓

NOISE ⇒ should not be there.

⇓

Harming High frequency.

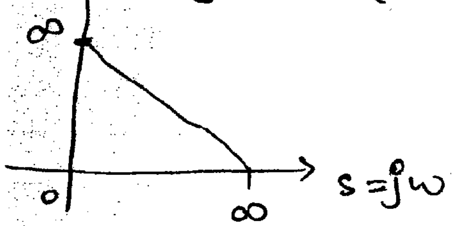
Adv. of LFT:

NOISE ⇒ can be eliminated by LPF. at high freq' values different

→ At low frequency, components are more stable.

The standard form of sm is represented as

$$sm = \frac{K(1+s\tau_1)(1+s\tau_2)(1+s\tau_3)\,----}{s^n(1+s\tau_a)(1+s\tau_b)(1+s\tau_c)\,----}$$



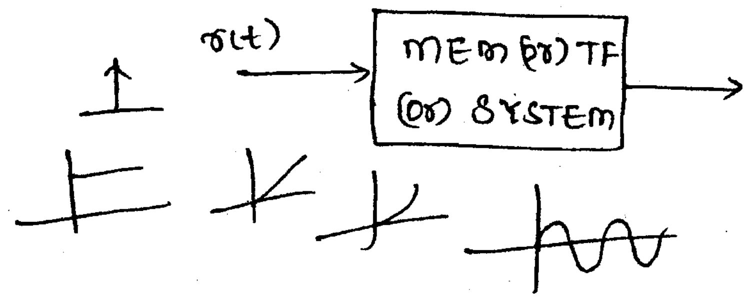
P > Z ⇒ LPF (there should not zero at origin).
⇓
strictly proper Transfer fn.

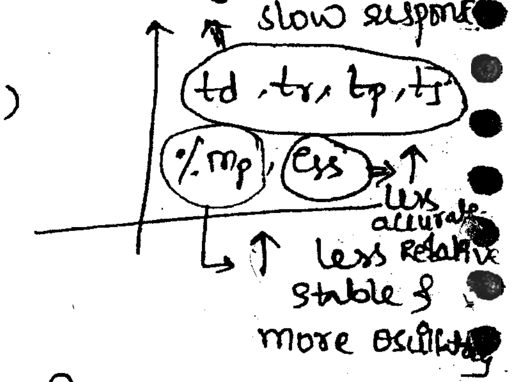
P = Z ⇒ LP | HP | All pass | BP | BS ⇒ proper T.F

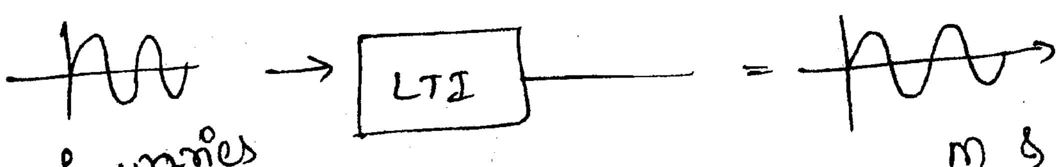
P < Z ⇒ Improper Transfer function

* To find overall T.F of a big sm's like industry's, BD, SFG are used.

<u>TDA</u>:







* To evaluate sm performance w.r.to time
⇓
⇒ TDA

Control Sm Specification:
Smallest tr, ts.

1) TDA Speed ⇒ tr, ts ⇒ ⇓ (V. Less) ⇒ quick response

2) FDA Accuracy ⇒ e_{ss} ⇒ ⇓ (very small) ⇒ more accurate

3) Stability ⇒ (Gm & Pm) FDA
- when both very large → more Relative Stable (adv) (Dis-adv) ⇓ But slow response.
- When both very less → (adv) → Less Relative Stable → More oscillator (Dis-adv) ⇓ tr ↓ ts ↑↑.

Optimum ranges
5dB to 10dB → Gm
30° to 40° ⇒ PM.

4) TDA Sensitivity w.r.to Noise, Disturbance, Environment condition (Tempaeature) etc.

The best Sm is Insensitivity w.r.to N, D, EC Etc

* Transient performance is improved means ⇒ speed of the performance improved.

Steady state " " ⇒ accuracy improved

Stability:

* ~~to find the~~ stability for closed loop sm only.

OL Sm
- ↓ G(s) ⇓ OLTF of a Sm
- ↘ OLTF → CLTF ↓ G(s), H(s) = 1 ⇓ OLTF of unity feedbac sm.

⇓

$$CLTF = \frac{G(s)}{1+G(s)}$$

CLTF $\quad$ $CLTF = \frac{C}{R} = \frac{G(s)}{1+G(s)H(s)}$

↙

$G(s)H(s) \Rightarrow$ OLTF of a Non-unity fb s/m

OL s/m
↓
OLTF $\Rightarrow$ of a s/m $\Rightarrow$ $G(s) = \frac{s+1}{s^2(s+2)(s+3)}$

poles locations are identified directly $\Rightarrow$ stability is identified $\Rightarrow$ stability tech. is not required.

CL s/m: OLTF of a unity fb s/m

$G(s) = \frac{s+1}{s^2(s+2)(s+3)} \Rightarrow CLTF = \frac{s+1}{s^2(s+2)(s+3)+s+1}$

CL poles locations are not identified directly hence required a stability technique to find CL stable.

The feedback changes the location of poles as order increases finding the new location of the poles is very difficult. Hence we required a stability technique to find the closed loop stability.

CL stability
- → TD → RH ⓘ / RL ⓶
- → FD → BP ③ / NP ⓵ → priority.

* According to Analysis TDA is best.
* Time Domain tech. gives the transient, SS.
* Freq " " " Steady state Analysis.

* Stability analysis is a steady state analysis.

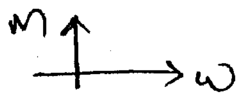
Transportation delay / lag sIm's.

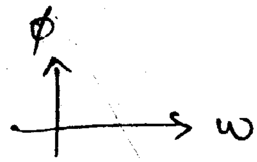
$L\{g(t-T)\} = e^{-sT}$

TD: $e^{-s\tau} = 1 - s\tau + \frac{(s\tau)^2}{2!} + \dots + \infty$ (Neglect)

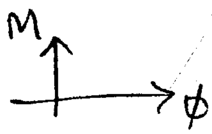
$= 1 - s\tau$

fD: BP:





NP:



$e^{+j\theta} = \cos\theta + j\sin\theta$

$e^{-s\tau} = e^{-j\omega\tau} \Rightarrow m = 1$

$\phi = (-\omega\tau)$

Bode plot are drawn only for minimum phase sIm.

① Adv. NP: ① No. of CLP Right hand side
② Range of K (Gain)
③ Relative stability. (RS)
④ pm & Gm

② Adv: Root locus:
→ Nature of the sIm is identified.

③ BP: → Gm & pm
→ RS.

④ RH: → Location of poles identified.