Modelling of system

what is Model ?

| vehicle |

toy.

kinetics >>
Fuel >>
Aerodynamics >)

? features ?

elemental description of any

system

Physical >>

Mathematical >>

A model must contain the dynamics of the system. mathematical modelling is not unique. It depends on the perspective.

electrical
circuit

$^{O/P}$ ⌐_/_ $_{i/p}$
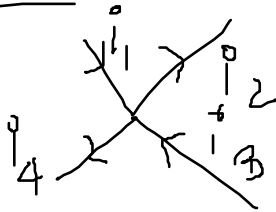
Mathematical modelling

A set of eqⁿs

Ex:-

Governing physics
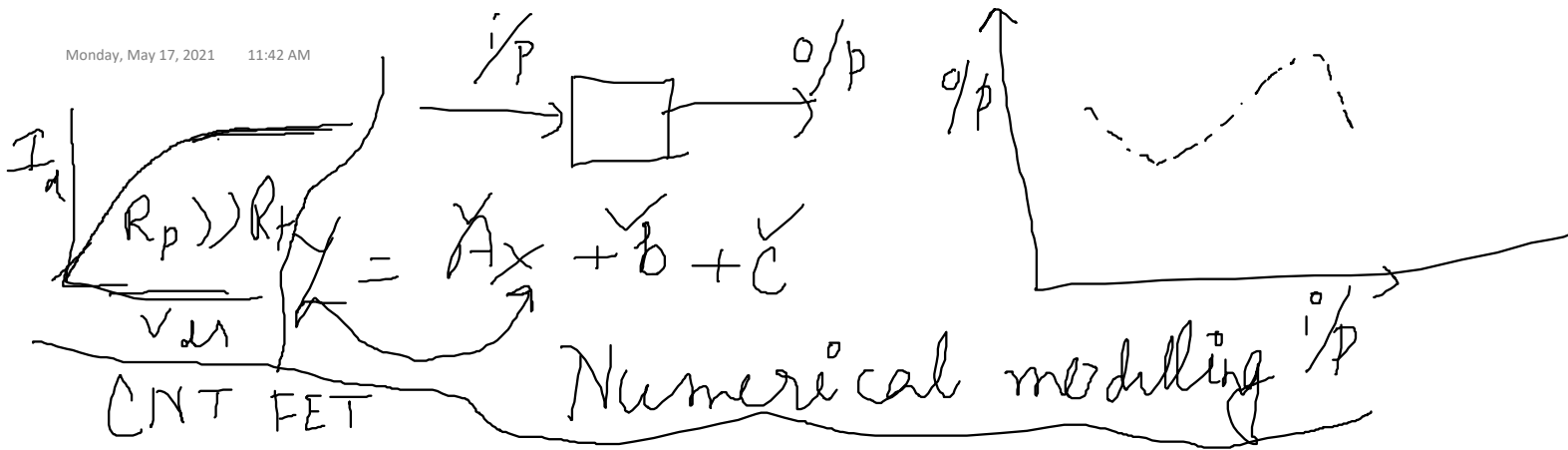
KCL / Bernoulli's eqⁿ

Types of mathematical modelling:-
1) Differential equation (time domain approach) ✓
2) State space modelling ()
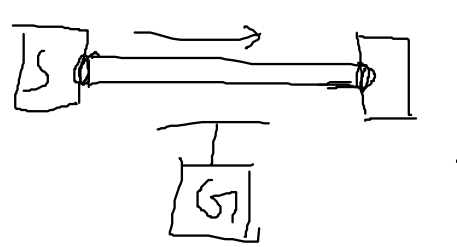3) Transfer function (frequency domain approach) ✓
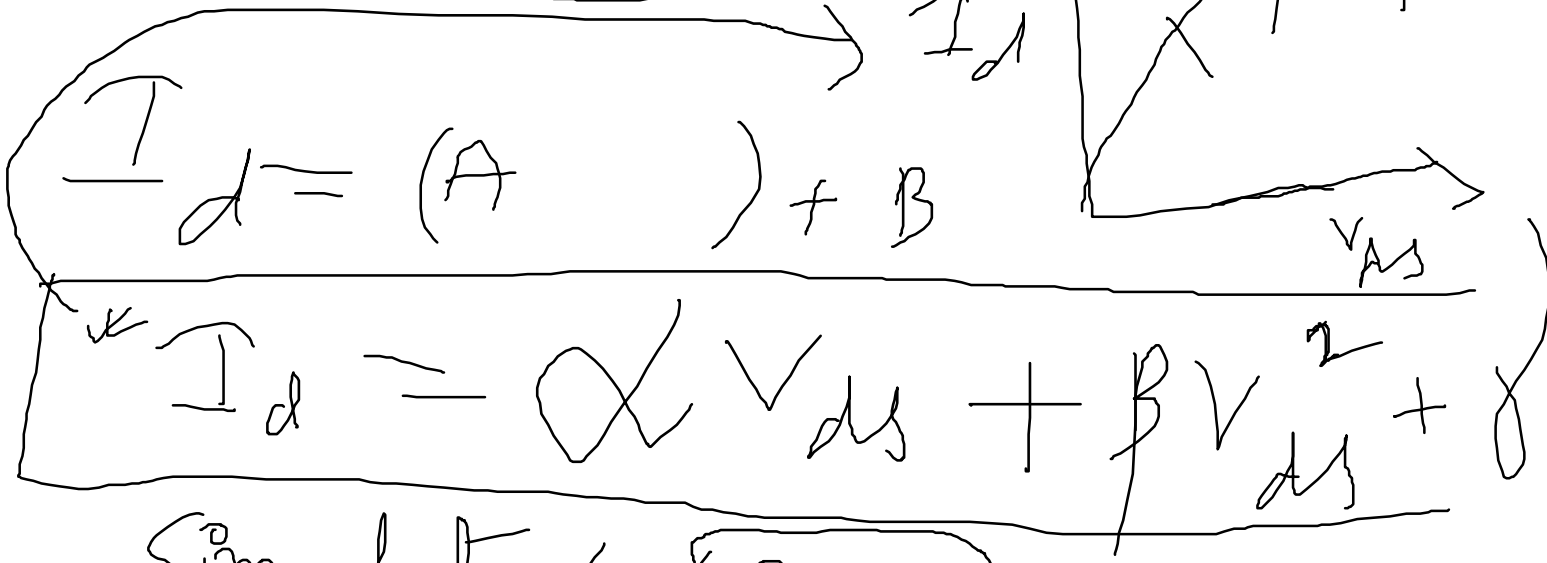
$t = 0$

State variables

$t \geq 0$ i/p
any time

SISO

MIMO

Numerical method modelling

I_d

$R_p \gg R_H$

V_{ds}

CNT FET

i/p

o/p

$= Ax + b + c$

o/p

Numerical modelling i/p

compact model
physics based

S   G

PTM

$$I_d = (A \qquad) + B$$
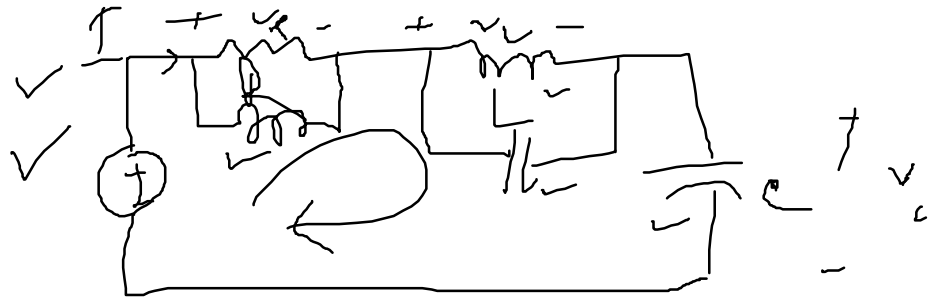
$$I_d = \alpha V_{ds} + \beta V_{ds}^2 + \gamma$$

Simulator/ BSIM

KVL

$$V = V_R + V_L + V_C$$

$$\frac{dv}{dt} = R\frac{dI}{dt} + L\frac{d^2I}{dt^2} + \frac{1}{C}$$

$$\Rightarrow \quad \frac{d^2I}{dt^2} + \frac{R}{L}\frac{dI}{dt} + \frac{1}{L}\frac{I}{C} = \frac{dv}{dt}$$

④

$$\frac{I(s)}{V(s)} = \frac{1}{R + Ls + \frac{1}{Cs}}$$

$$= \frac{Cs}{1 + RCs + LCs^2}$$

$$\frac{d^2 I}{dt^2} + \frac{R}{L}\frac{dI}{dt} + \frac{1}{L}\frac{I}{C} = \frac{1}{L}\frac{dV}{dt}$$

$$\boxed{t \geq 0}$$

I have written a set of 2 1st order differential equation instead of the 2nd order DE.

$$\frac{dI_L}{dt} = -\frac{R}{L}I - \frac{1}{L}V_C + \frac{V}{L} \cdots \text{①}$$

$$\frac{dV_C}{dt} = \frac{I_L}{C} \cdots \text{②}$$

$$\begin{bmatrix} dI_L/dt \\ \dfrac{dV_C}{dt} \end{bmatrix} = \begin{bmatrix} -R/L & -1/L \\ 1/C & 0 \end{bmatrix} \begin{bmatrix} I_L \\ V_C \end{bmatrix} + \begin{bmatrix} 1/L \\ 0 \end{bmatrix} V$$