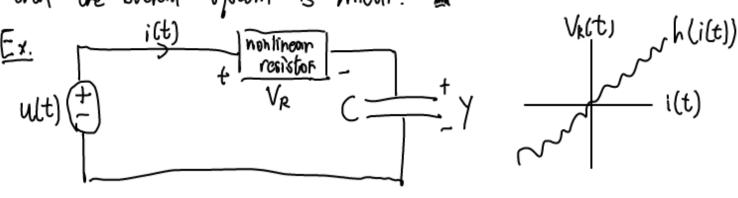
| Ch. 2 Morthematical Models of  | f System   |
|--|--|
| -Sor control design, we need a                                       | a 'good' math madel of the plant   |
| 'good' := simple but acou  | irate  |
| 2.1 General Comments on M  | odalling   |
| - a model is a set of equi   | nations that represent a system.   |
| - models allow us to simulate, effective & safe way.                 | test, and refine designs in a cost   |
| Apply known "laws"  (Newton, KVL, E.M., queuing etc.)                | "aperating point"  |
| ound/or<br>System Identification<br>(experiments, data fitting etc.) | System of differential equations   |
|  | System of linear differently system of equations   |
| Isolate relationship between ?                                       | equations  Take LTs w/ Zeno initial conditions   |
| Transfer<br>y Finction   |  |
| Expainantally determine parameter values in TF                       |  |
| Ex. 2.1.1. (marg-spring-dan  | mpor) 9 E/R, pos of mag  ME/R, mass in kg  |
| Spring   | UE/R, applied some   |
| Jamper VV  | $\Rightarrow$ $\mathcal{N}$ $q = \frac{dq}{dt}$ , valuely $\hat{q} = \frac{dq}{dt^2}$ , acceleration |
| ,  | V *  |

Take of, to be the position, where oping is not compressed (stretched). Newton's 2nd Law: Moj = I forces acting on M Force due to spring (onesumed linear, Hooke's Law) Fig = Kg (motion)

in damper (possibly non-linear, models Solution) clip) C://R=JR (opposes notion) |Mg= U-kg-c(g) | 2nd order, Non-linear, ODE If the damper were linear, i.e., C(qi) = bq, b constant than the overall system is linear.



Vr(t) = h(i(t)), h: R→ R ult) - applied voltage Ylt) = voltage across capacitor

Apply KVL: -u(t) + Ve(t) + y(t) = 0  $Ve(t) = h(i(t)), i(t) = \left(\frac{dy(t)}{dt}\right) \text{ (capositor device eqn)}$   $= \sum -u(t) + h(cy) + y(t) = 0 \text{ ODE}$ 

If the register were linear, i.e. h(i) = Ri, R constant then the circuit is linear (see Ex. 2.3.4)

2,4 State-Space Models

- state-space models are a way of expressing math models in a standard form.

EX, 2,4.1

 $M_{\hat{\gamma}} = u - D(\hat{\gamma})$ 

We put this model into a standard form by defining two so-called "state variables"