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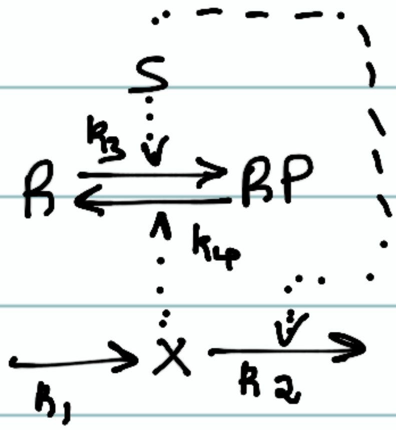
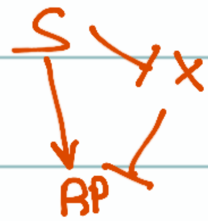




S has -ve effect on X

S promotes RP

X -vely affects RP

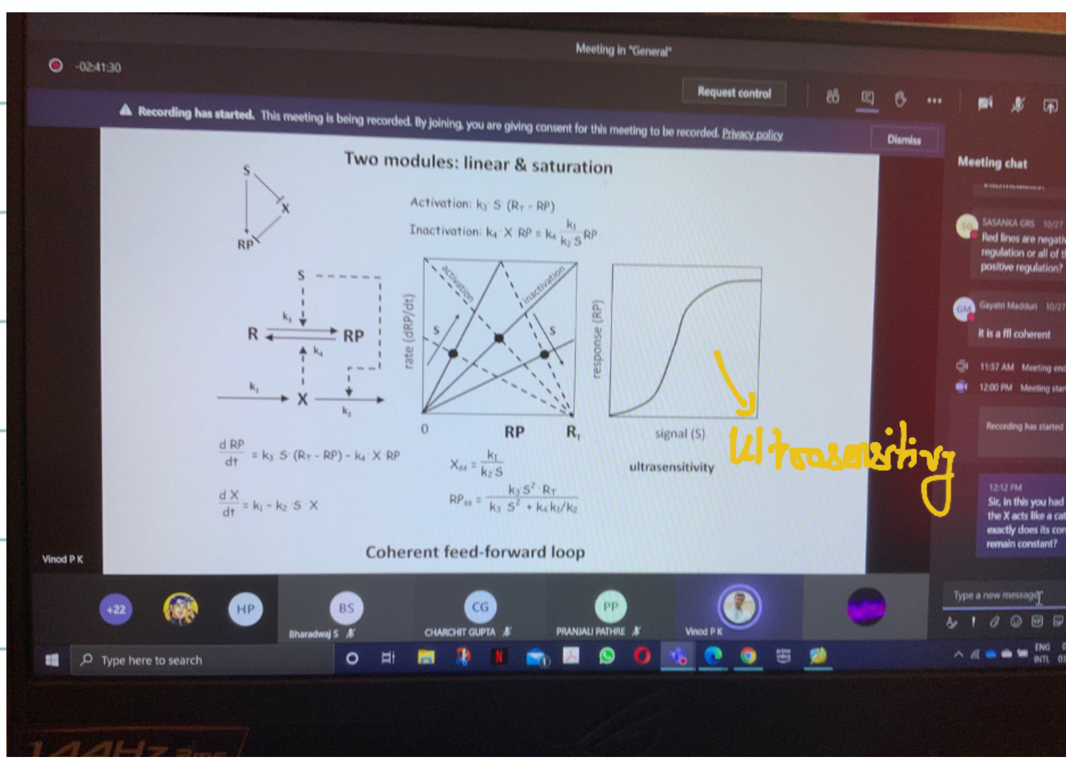
Hybrid Network

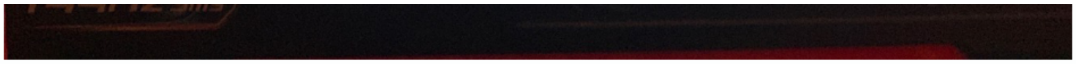
$$\frac{dRP}{dt} = \underbrace{k_3 S\,[R_T - RP]}_{V^+_{Activation}} - \underbrace{k_4 X RP}_{V^-_{Inactivation}}$$

R_T: R_{Total}

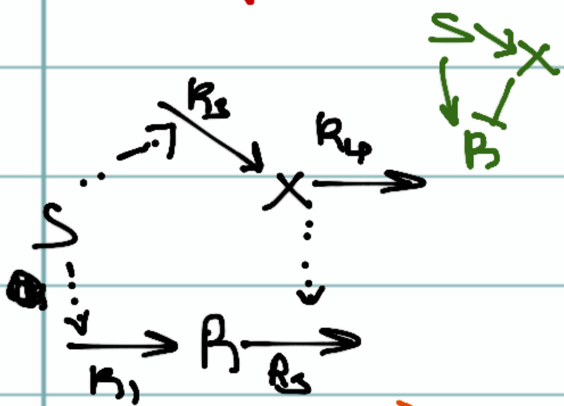
$$R_T = R + RP$$

$$\frac{dX}{dt} = k_1 - k_2 S X$$





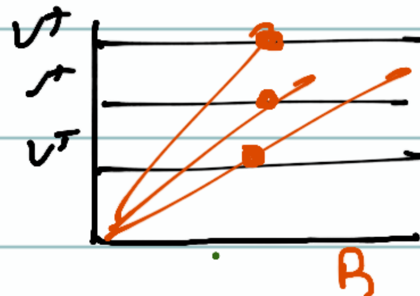
Combining protein synth, degr with activation/inactivation



$$\frac{dR}{dt} = k_1 S - k_2 X R$$

$$\frac{dX}{dt} = k_3 S - k_4 X$$

Incoherent FFL

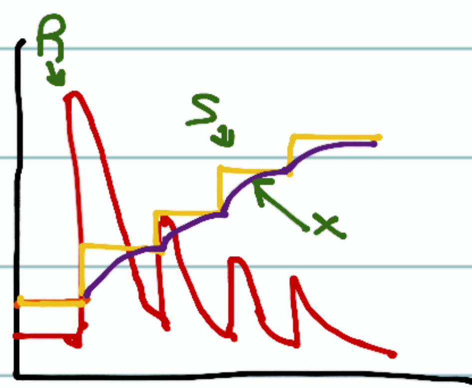


v^+ is constant

V^- is going to change linearly

Function of parameter X is independent of signals [S]

Though V^+, V^- changes
Steady state is same i.e
shows adaptation



Called sniffers and example
can be taken as outd response

level to same stimus keeps reducing as our brain is more suited to it

Sensory System
- Smell
- Hear
- Vision

All based on adaptation

"Relative perception" - Weber's Law [Revise this once]

$\Delta x = k . x$

Background signal

If a person has 100g and if 1g is being added, person can identify change only when it reaches a threshold

$x \rightarrow$ weight
$\Delta x \rightarrow$ increase

$\Delta x = k x$

Background signal.
Could we smell, lights etc

05 November 2020 01:56

$\Delta x = kx$

↑ Background signal can be smell, sight etc

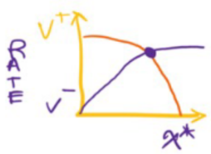
Examples

$\Delta x = (0.1)(100)$

$\Delta x = 10$ ← Need change to identify it

Adaptation → I-FFL

$x \rightleftarrows x^*$ } Protein modifi & demodification



If $X \rightleftarrows X^*$ ← Feedback

→ Starts to come down with increase in x due to this factor

x^* will reach x_{Total}

$$\frac{dX^*}{dt} = k_a[X^*][X_T - X^*] - k_i X^*$$

↑ Activation ↑ Inactivation

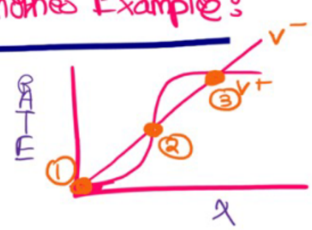
So change be controlled due to which number stable points can be modified

①, ③ are stable ⟹ Bistable System

② is unstable

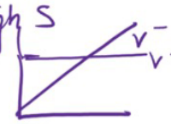
Activation type system

Another Example:



→ Synthesis type System

⟹ For high S



} only one stable point

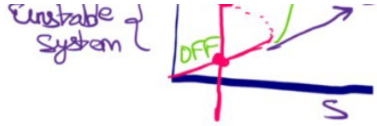
In both cases ①, ③ are stable

② is unstable

As signal value changes, curve will have a change as follows

→ Stable Region

→ Very discrete with jumps



→ Possiblity of very fast jumps

· but slower movement along steady states

As signal changes increases, we can have threshold after which x jumps from one stable state to another.

Acts like a bistable switch

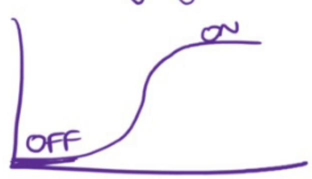
If signal keeps decreasing, won't be able to turn it off like a toggle switch which is a aspect of memory.

→ Irreversible [Can't fall back/switch it off]

As they are irreversible they have memory

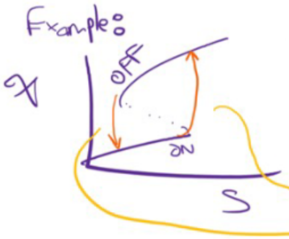
→ By plotting with S, we can find region of bistability.

⇒ If we want one steady state, we can keep threshold very high



Reversible Switch

Example:



Two threshold system

↳ one for activation

↳ one for inactivation

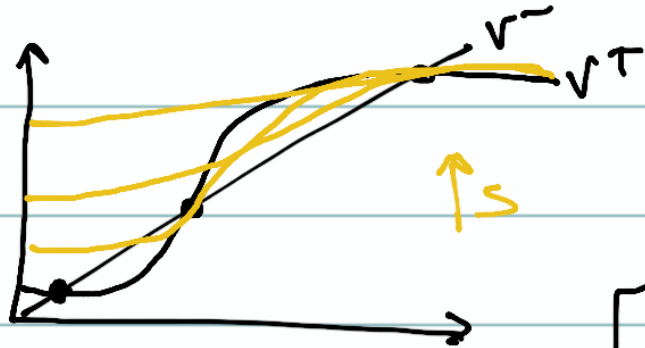
If input is too noisy along threshold then can keep switching!

To avoid this, two threshold system can be used and reduce the noise.

Finally

Ultrasensitive switch
Bistable switch

Positive feedback



As signal strength increases

V^+ is lifted up entirely

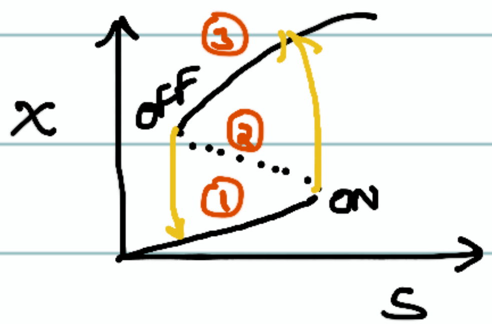
This also contributes to change in number of steady states as we see after a point there is only one steady state point.

$3 \to 2 \to 1$

Lifting up/down

Sigmoidal part

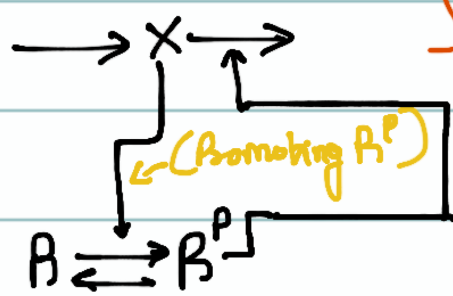
$$\frac{dx}{dt} = \underbrace{k_s S + k_s' \frac{x^n}{x^n + K^n}}_{V^+} \underbrace{- k_d x}_{V^-}$$



Here also as S increases, 1,2 come to each other.

Then ①,② coincide, on further increase, ① & ② destroy each other leaving out only ③, the only steady state

Hybrid System



} X synthesis / degradation

→ (R^P promoting degradation of X)

R modification/demodification

Taking R_P are output;
Here X inhibits R^P
when R^P inhibits X.

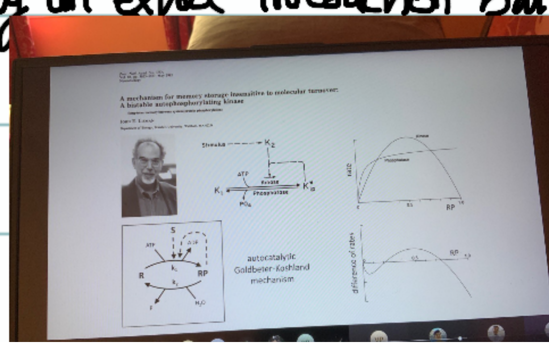
$X \dashv R^P$, $R^P \dashv X$

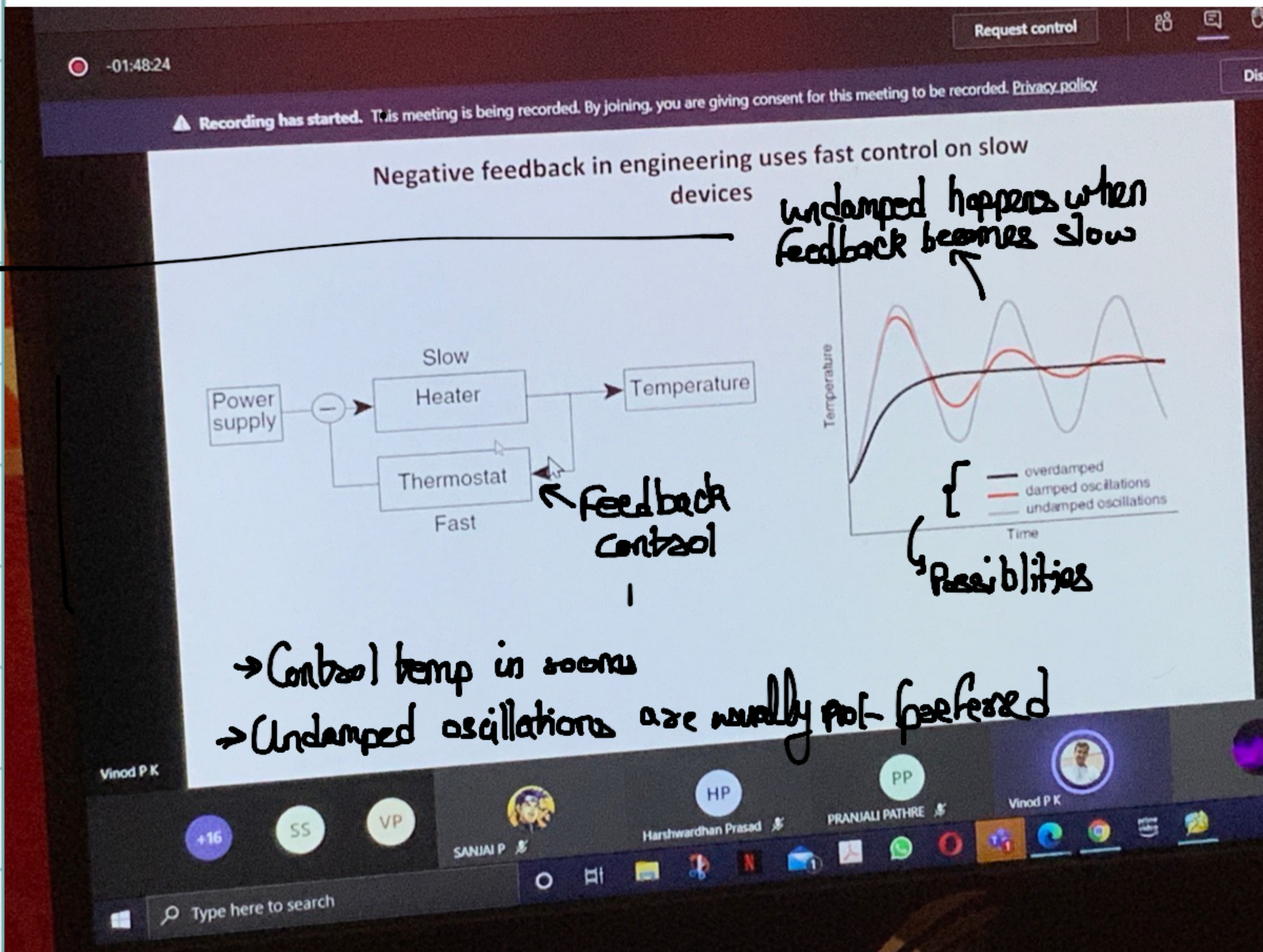
It is bistable

This above system is a $\boxed{\text{incoherent-FFL}}$

→ Osmoadaptation is -ve feedback system

→ To go from zero-order ultrasensitivity to having a bistable response, only an extra-interaction but adding feedback





undamped happens when feedback becomes slow

Feedback control

Possiblities

→ Control temp in rooms

→ Undamped oscillations are usually not preferred

If feedback becomes slow, thermostat will feedback error of past. So, its a possiblity for resulting in a undamped system

→ Acts like a hybrid system with both fast & slow loops

Eg: Activation & Inactivation

Eg: Protein synthesis & degradation